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PHOTOGRAPHY IN THE FRENCH ARMY.

How vague the classical description is, according to the color of the eyes, hair, and beard, and the shape of the nose and mouth, is well known. When a gendarme or a rural guard has read that such or such a one has an oval face, a medium sized mouth, medium sized forehead, medium sized nose and auburn hair, it is very difficult for him to recognize any particular person. Yet, up to the present, for shooting licenses and soldiers' "livrets," nothing better has been found. We have photography, indeed, but that is expensive and necessitates manipulations such that it cannot be used in the army, especially where 200,000 individual livrets and as many registering books have to be drawn up annually. Were it possible to succeed in photographing portraits in the livrets themselves, or on shooting licenses and on diplomas, how much easier it would be to recognize an identity!

This problem has interested the Duke de Morny. Like many other persons, he has made himself an amateur photographer, and has acquired a remarkable dexterity. He has even succeeded in sensitizing the commonest paper and in directly obtaining a portrait upon any sort of written or printed document. From research to research, he has improved photographic processes to such a point that he is able to obtain two portraits for the sum of one cent.

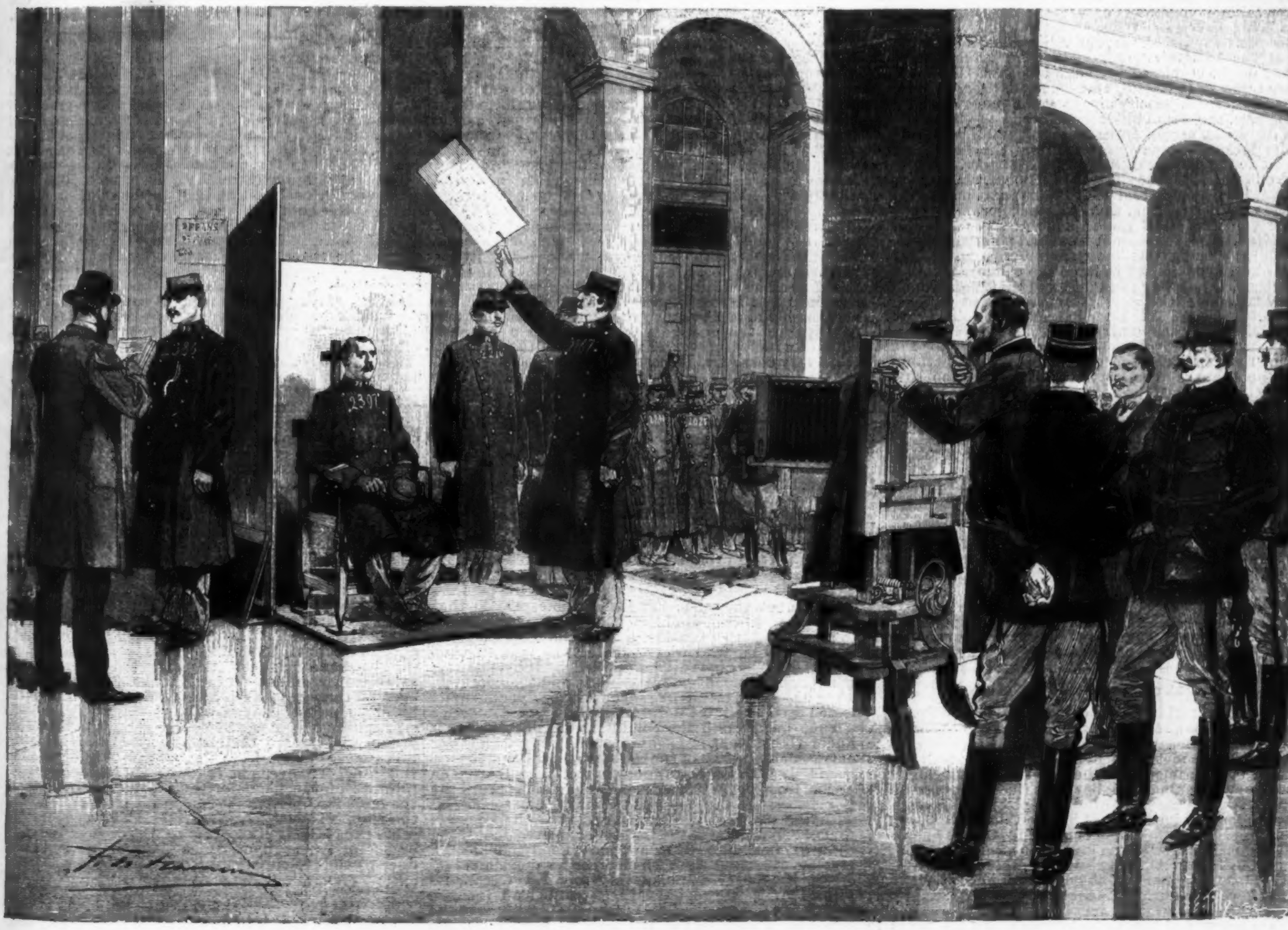
Now, an endeavor has been made for a long time to complete the military livret by an unexceptionable evidence of identity. There is, to be sure, the brass plate that every man suspends from his neck on starting upon a campaign, but this may be stolen and does not prove much. The Duke de Morny, in the name of the Lux Society, of which he is president, asked the military authorities to test his invention. To this effect, the 76th regiment, in barracks at the Chateau d'Eau, Paris, furnished a company of one hundred men, who had to pass in front of the ducal objective. The operation exceeded all hopes. Thanks to the ingenious arrangements of the apparatus and to the stability of the seat upon which the soldier sits, twenty-five portraits may be obtained upon the same plate in a few seconds. The duke asserts, even, that he will succeed in obtaining eighty-one portraits; but, with plates of twenty-five divisions, it is already possible to photograph two thousand men in twenty hours.

While this system was under experiment at the Chateau d'Eau, the captain in charge of the experiments asked himself whether it would not be possible to find a still more unexceptionable proof of identity, for it is so easy for a man to modify the cut of his beard. He had a stroke of genius; taking a piece of chalk, he wrote the registry number in large figures upon a soldier's breast plate and then passed white over the regiment number inscribed upon the collar. The result was superb; every portrait gave these indications.

Thenceforward, one was in possession of valuable elements. The use to be made of the invention remained. A place where the portrait might be put was sought for from page to page of the livret. Alongside of the description? That was seductive, but, since the paper had to be wet for sensitizing, it was to be feared that the manuscript portions would be destroyed. It was finally decided to photograph upon an isolated page that would afterward be sewed into the livret.

It is to be anticipated that the military authorities are to adopt this valuable means of identification, which will render the task of the gendarmerie and recruiting officers so easy. From another point of view, the individual livret will permit of much more rapidly recognizing the dead upon the battle field. It will be a sorrowful and valuable souvenir for families, which, very often, will have no other image of the dear departed.

If photography enters definitely into the uses of the army, the day on which our soldiers defile before the apparatus will be the most curious of the military year. This may be judged of from the sketches that we have been permitted to make from life during the experiment at the Chateau d'Eau.—*L'Illustration.*



PHOTOGRAPHY IN THE FRENCH ARMY.

[FROM THE SUN, NEW YORK.]

SCIENCE AND THE SPIRITS.

A SCIENTIFIC investigation of mediumistic phenomena was recently made in Milan. As some of the investigators were world renowned, great interest was felt throughout Italy, and the results of the experiments excited much discussion.

Among the investigators were Schiaparelli, the discoverer of the lines on Mars, and Prof. Lombroso, of Turin. The majority of the investigators were not believers in spiritualism; each came with his own theory explaining the phenomena. Schiaparelli was perhaps the only one who had no theory whatever concerning them. He had been told by his friend Zollner, the astronomer, that there was something true in spiritualistic phenomena; of this Zollner had become convinced during his researches for proofs of a fourth dimension.

The scientific men met in Milan in September last. The medium was Eusapia Paladino, a Neapolitan, whose fame has spread throughout Europe. She is a robust-looking little woman, about thirty-five years of age. She is married. Her husband is a carpenter, and she is an ironer. It was discovered when she was quite young that she seemed to possess some strange power. No one could understand what it was. When she was asked what she thought it was, she said: "How do I know what it is?" The people of the class to which she belonged, being ignorant, ridiculed her; and, as the fatigue of exerting the strange force was very great, she concluded that it was not worth while to exert it. Indeed, she took such an aversion to the mysterious influence that for ten years she never experimented with it. It was only through the insistence of Signor Ercole Chiajia that she was induced to do so again.

Signor Chiajia is a gentleman living in Naples. He has been distinguished by the king, and is a man of means. He could hardly be suspected of having dubious motives in bringing Eusapia to the attention of

people, especially as she does not give public sittings. His motive has been to call her to the notice of scientists.

When it became known that these sittings were being held in Milan, an editor of one of the daily papers published an article in which he offered to bet 3,000 francs that Eusapia was a humbug, and that the phenomena were produced by trickery. He professed to be able to explain the tricks, and declared that she could not produce one of the phenomena under conditions stated by him. Eusapia is an ignorant woman; she cannot even read or write. Prof. Aksakow, one of the investigators, answered for her, saying that at his request she had placed herself at their disposition for a scientific examination of the phenomena, and that as he and some of the other investigators had come from a distance, and had no more time than was necessary for that purpose, they did not wish to be interrupted. If the journalist was able to expose any trickery he begged him to do so, and they would thoroughly investigate the matter.

After some delay the journalist explained the phenomena as being performed cleverly by Eusapia changing her hands and feet about in such a way that the two persons holding her believed that they each held a hand and a foot, while they both held the same hand and foot; thus she had the other hand and foot free to work with. The lights he explained as being phosphorus on her fingers. The moving of heavy objects at a distance, the appearance of hands, figures and the like, he accounted for as being the work of an accomplice. This explanation satisfied the public at large, but seemed to have no effect on the scientific men, who continued their researches. From time to time remarkable things were told of what took place at the sittings.

One day another editor, happening to meet Eusapia in the street, asked her to walk home with him, as his wife wished to meet her. Eusapia went. At the editor's house the kitchen table was brought in and the members of the family seated themselves around it. The table immediately arose from the floor about six inches, and remained suspended in the air for several seconds. It was about four o'clock in the afternoon and the windows were open. Eusapia asked that they might be closed. The blinds were closed. The room was even then light enough for them to see Eusapia's form distinctly and to watch her movements; however, the usual phenomena occurred—the moving of furniture, noises, appearance of hands, and so on. The journalist was impressed, and the next day he took up the defense of Eusapia in his paper. He pointed out the fact that she was in a house where she had never been before, and that no preparation had been made for her coming, as it was unexpected. She was a stranger to all of them; none of the party was a spiritualist, and she could have had no accomplice.

This journalist was known and respected, but in the opinion of the public at large the whole question was odious. One paper even declared that it was against the decorum of the city. The mayor went to investigate the matter. He attended one of the sittings with the scientific men. These sittings were held in a palace in Via Monte di Pietà, the home of Signor Finzi. The room in which the experiments were performed is the library. The mayor said that in the sitting which he attended he felt pass over his face a large, damp, hairy hand, which certainly was not the hand of Eusapia, though he really could not say whether or not it was the hand of a spirit.

Signor Schiaparelli, being asked by a reporter if he believed in the phenomena, said: "How can I say that I believe a thing which I can account for in no way? I should define the phenomena as mediumistic, and I consider them of great interest to science."

Prof. Broferio, who took the 10,000 franc prize offered by the Italian government for the best scientific article of last year, said that he thought the way to explain the phenomena collectively, in the easiest and most probable way, was to call them the work of spirits.

The public at large, with true Italian indifference, said that it was all a thing for scientific men and lunatics; but the report of the investigators was read with interest. Here is their report in part:

REPORT OF THE MEN OF SCIENCE.

In consideration of the evidence given by Prof. Cesare Lombroso, regarding the mediumistic phenomena produced by means of Signora Eusapia Paladina, the undersigned met here in Milan to hold with her a series of experiments for the purpose of verifying such phenomena, submitting her to as rigorous observation as possible. We held in all seventeen sittings, which took place in the house of Signor Finzi, Via Monte di Pietà, between the hours of 9 and 12 in the evening.

The medium, who was invited to come to these sittings by Signor Aksakow, was presented by Cav. Chiajia, who was present at only a third of the sittings, and generally during the first and least important part of them.

On account of the agitation made by the press in announcing these sittings, and seeing the diverse opinions of the press in regard to Signora Eusapia and Cav. Chiajia, it seems well to publish the following brief account of what we have seen and experienced.

Before entering upon the subject, however, it will be well to say at once that the results of the experiments did not always correspond to our expectations. Not that we have not had, in great abundance, facts which were apparently or really important and marvelous; but in the greater number of cases it was impossible for us to apply to the same those rules of experimental art which in other fields of experiment are considered necessary for arriving at sure and incontestable results. Among these rules, one which is most important is to vary one by one the circumstances of experiment in such a way as to isolate the true causes, or at least the true conditions of every fact. Now it is precisely in this regard that our experiments seem to us only too deficient. It is true that many times the medium, in order to prove her good faith, spontaneously offered to change certain details of the experiments, and from time to time introduced such changes of her own accord; but these were concerning circumstances which were of trifling importance according to our way of thinking. On the other hand, the changes which in our judgment seemed necessary, in order to remove every doubt, were either not accepted by the medium, or, if they were put into effect, resulted usually in rendering the experiment null, or at least were conducive to results which were not clear.

We do not consider ourselves as having the right to interpret this fact by injurious suppositions, which to many seems the simplest way. We think, rather, that this has to do with phenomena of an unknown nature, and confess that we do not know the necessary conditions for their being produced. To wish to fix or dictate such conditions according to our own ideas would, therefore, have been quite as unreasonable as it would be to insist upon making the experiment of a Torricelli barometer with a tube having a hole in the bottom of it, or to make electric experiments in a place saturated with moisture, or experiments of photography exposing the sensitive plate to the light rather than in the camera obscura. Admitting all this (and no reasonable man can doubt it), the fact still remains that the said impossibility of varying the experiments as we wished singularly diminished the value and interest of the experiments performed, taking away in many cases that demonstrative rigor to which in facts of this nature we have the right and also the duty to aspire. Therefore, in many cases, ours were not true experiments, but simply observations of that which happened under given circumstances, not fixed, indeed, not wished for by us.

For that reason we will not mention those experiments which seemed to us not to be sufficiently demonstrated, and we will touch lightly upon those regarding which the conclusions could easily be diverse among the various experiments. We will note more minutely the circumstances in those which, in spite of the obstacles above mentioned, it seems to us we have arrived at a degree of certainty.

PHENOMENA OBSERVED IN THE LIGHT—LIFTING OF A TABLE LATERALLY BENEATH THE HANDS OF THE MEDIUM SEATED AT ONE OF ITS ENDS.

We employed for this experiment a pine table, 1 meter 10 centimeters long, 80 centimeters in height, weight 20 pounds. Among the several movements of the table, by which answers to questions were given, it was impossible not to observe especially the motion made during the raps; two legs of the table were raised simultaneously beneath the hands of the medium, without the slightest lateral oscillation of the table preceding, with force, rapidly, and several times in succession, as if the table had been glued to the medium's hands; a motion more remarkable from the fact that the medium was always seated at one end of the table, and we did not release her hands and feet for an instant. As this phenomenon is produced usually with the greatest ease, to observe it better we, on the evening of October 3, left the medium alone at the table, with both her hands above it completely, and her sleeves rolled to the elbow. We stood around the table, and the space above it and below it was brightly illuminated. Under these conditions the table raised itself to an angle of thirty or forty degrees and remained in that position several minutes, while the medium held her limbs stretched out and beat her feet one against the other. Then producing a pressure with our hands upon the raised side of the table, we felt a very considerable elastic resistance.

MEASURE OF FORCE APPLIED IN RAISING THE TABLE LATERALLY.

For this experiment the table was suspended by one of its ends to a dynamometer attached to a rope fastened to a small beam which rested upon two wardrobes. The end of the table being lifted to a height of fifteen centimeters, the dynamometer indicated a pressure of about eight pounds. The medium was seated at that end of the table with her hands completely above the table, to the right and to the left of the point at which the dynamometer was attached. Our hands made a chain upon the table without making a pressure upon it; for that matter our hands could not in any case have acted in any way except to augment the pressure exerted upon the table. The wish was expressed that the pressure should diminish, and soon the table began to raise itself up from the side of the dynamometer. Signor Gerosa, who was watching the indicator, announced these diminutions marked by the successive indications seven, five, three pounds, and then nothing, after which the lifting was such that the dynamometer rested upon the table horizontally.

Then we reversed the conditions, placing our hands under the table, the medium putting her hands not only under the edge of the table, where she would have been able to touch the framework of it and exert an action from below, but placing them underneath the framework uniting the legs. She did not touch this with the palms of the hands, but with the backs of them. Thus none of the hands could have done other than diminish the tension upon the dynamometer. Having expressed the wish that the tension should increase instead of diminish, very soon Mr. Gerosa informed us that the indications marked an increase from eight to fifteen pounds. During the whole of the experiment both feet of the medium were under the feet of those to the right and to the left of her.

COMPLETE LIFTING OF THE TABLE.

It was natural to conclude that if the table could lift itself, against every law of gravity, on one side it could also lift itself entirely. In fact this occurred. This lifting is one of the most common phenomena with Eusapia, and permits the most satisfactory examination. It is produced usually under the following conditions. The persons seated around the table lay their hands upon it, forming a chain. Each of the medium's hands is held by the hands of those seated next her. More than that, they pressed her knees with theirs. As usual, the medium was seated at the end of the table, the position most unfavorable to mechanical raising of it. In a few moments the table made a movement laterally; it lifted itself to the right and then to the left, and finally raised itself completely, with its four legs in the air horizontally, as if floating in a liquid, to a height of from ten to twenty centimeters, at times from sixty to seventy centimeters, then fell to the floor on its four legs simultaneously. Sometimes it remains in the air several seconds and makes fluctuating movements, during which we can examine thoroughly the position of the feet beneath it. During the lifting of the table the right hand of the medium often leaves the table locked in that of her neighbor and remains in the air above it. Throughout the experiment the face of the medium is contorted, the hands contract, she groans and seems to suffer, as is usually the case when a phenomenon is to take place.

In order to examine better the facts in question, we withdrew from the table one by one, having discovered that the chain of hands on the table was no longer necessary, either in this or other phenomena. Finally there was but one person left at the table with the medium. That person rested his foot upon both Eusapia's feet, and placed one hand upon her knees. With his other hand he held the left hand of the medium. Her right hand was laid on the table in plain sight, or even raised above it in the air while the table was elevated.

MANIFESTATIONS PHOTOGRAPHED.

As the table remained in the air for several seconds, it was possible to take a number of photographs of the phenomenon. Up to this time this had never been done. Three photographic outfits acted at the same time in different parts of the room. The light necessary was produced by a magnesium light thrown on at the opportune moment. There were twenty-one photographs obtained, several of which were excellent. In one of them, the first one made, Prof. Richel is seen holding the hands, feet and knees of the medium; her other hand is held by Prof. Lombroso. The table is being raised horizontally, which is shown by the space between the extremity of each leg and the extremity of their respective shadows.

In all the preceding experiments our chief attention was turned to controlling the hands and feet of the medium, and as regards them we feel ourselves able to say that they played no part in the phenomena. Nevertheless, for the sake of exactness, we cannot pass over a fact which became evident to us only on the 5th of October, but which probably existed in the previous experiments only. It consists in this, that all four of the legs of the table could not be said to be entirely isolated during the raising of the table, for at least one of them came in contact with the dress of the medium.

CURIOUS PUFFING OF THE MEDIUM'S SKIRT.

On that evening we noticed that, shortly before the elevation of the table, the left side of the skirt of Eusapia's gown began to puff out so that it touched the table leg. One of us having tried to prevent such contact, the table did not rise as usual, and we found that it did so only when the observer allowed such contact. This is seen in the photograph taken from that side, and also in those where the leg in question is visible in its lower extremity. It is noticeable that contemporaneously the hand of the medium is placed on the surface of the table on that side, so that that part of the table was under the influence of the medium from the lower portion by means of the gown as well as from the upper part by means of her hand. Nothing could be verified as to the grade of pressure exerted by the hand of the medium at that moment upon the table, nor was it possible to discover, the elevation of the table being so brief, what part the simple contact of the gown (when appeared to be applied laterally) could have had in sustaining the weight of the table. We tried to avoid the contact of the gown by requiring the medium and all others at the table to stand up, but the experiment did not succeed. We proposed putting the medium at one of the long sides of the table, but the medium opposed this, saying it was impossible. We are obliged, therefore, to acknowledge that we did not succeed in obtaining a complete uplifting of the table, with all four of its legs absolutely free from contact, and there is reason to fear that an analogous difficulty may have taken place in the lifting of the two legs which were on the side of the medium.

In what manner the contact of a thin gown with a leg of a table (at the lower part of it, moreover) would be able to aid in the lifting of the table we are not able to say. The hypothesis that the gown may have hidden a solid prop, introduced to serve as a momentary support to the leg of the table, is not plausible. To maintain the entire table held up on that one leg by means of an attrition which a single hand can make applied on the upper surface of a table would require that the hand should exert an enormous pressure, such as we are not able to believe Eusapia able to exert, not even for three or four seconds. Of this we are convinced by attempts made by us upon the same table. The only movements of the table not subject to this cause of uncertainty are those where the two legs of the table most distant from the medium are lifted; but this kind of movement is easily produced by a light pressure of the hands of the medium on the sides of the table next her, and it is not possible to give to this the slightest demonstrative value. The same may be said of the lateral lifting of it on the legs to the right or left of the medium, which the medium could produce by the pressure of even one hand.

VARIATION OF PRESSURE EXERTED BY THE WHOLE BODY OF THE MEDIUM SEATED UPON A BALANCE.

This experiment was very interesting but very difficult, because, as can easily be understood, every movement, voluntary or involuntary, of the medium upon the platform of the scales would cause an oscillation of the platform and also of the steelyard. In order to have the experiment conclusive, it would be necessary that the steelyard, when it had changed position, should remain stationary for a few seconds, to permit one to suspend the weights on the steelyard for measuring. With this hope we made the attempt. The medium was made to sit upon a chair placed upon the platform of the scales, and we found that the weight marked for both was 163 pounds. After a few oscillations there occurred a decided descent of the steelyard, which lasted several seconds, and which allowed Signor Gerosa to measure the weight immediately. It indicated a pressure of 130 pounds—that is to say a diminution of 33 pounds. The desire being expressed that opposite phenomenon should occur, the extreme end of the steelyard immediately arose, indicating an augmentation of twenty-five pounds. This experiment was repeated several times and at five different sittings. Once it did not succeed, but the last time a regulating apparatus enabled us to obtain two extremes of the phenomenon. We tried to produce the same deflection ourselves, and were not able to produce it except by several of us standing on the platform and bearing first on one side and then on the other side of it near the

edge, swaying our bodies violently, a movement which we never saw in the medium, and which was impossible in her position on the chair. Notwithstanding, we recognize that the experiment cannot be said to be absolutely satisfactory until we complete it with what will be described later.

In this experiment of the scales it was noticed also that its success seemed to depend upon the contact of the medium's dress with the floor upon which the scales were placed. This was verified with an opposite experiment on the evening of Oct. 9. The medium was placed upon the scales. The one of us who was appointed to watch her feet saw the lower folds of her dress swelling out and protruding over the edge of the platform. Whenever we tried to prevent this (which was certainly not produced by the feet of the medium) the levitation did not take place, but as soon as we permitted the hem of the dress to touch the floor the repeated levitations took place, and were marked by broad curves on the registering dial. Once we tried the levitation of the medium, placing her upon a broad pallet, placing that upon the platform. The pallet prevented the contact of the dress with the floor, and the experiment did not succeed.

Finally, on the evening of Oct. 13 another balance was prepared, a Roman balance, with the platform isolated completely from the floor, and distant from it thirty centimeters. Carefully watching and not permitting contact of any sort between the platform and the floor, not even by means of the hem of Eusapia's dress, the experiment failed. On the other hand, in similar circumstances, a slight result seemed to be obtained on Oct. 18, but on that occasion the experiment was not certain, there being a chance that the mantle which Eusapia requested should be wrapped about her head and shoulders had touched the arm of the balance during the incessant agitation of the medium. We conclude, therefore, that no levitation succeeded with us while the medium was completely isolated from the floor.

SPONTANEOUS MOVEMENT OF OBJECTS.

Often a chair placed for the purpose, not far from the table between the medium and her neighbor, began to move, and advanced toward the table. A remarkable instance occurred during the second sitting. This took place in full light. A chair weighing twenty-five pounds, which was at a distance of a yard behind the medium, approached Sig. Schiaparelli, who was sitting near the medium. He arose and put it back in its former place, but when he was seated again the chair came up to him a second time.

MOVEMENT OF THE STEELYARD OF THE SCALES.

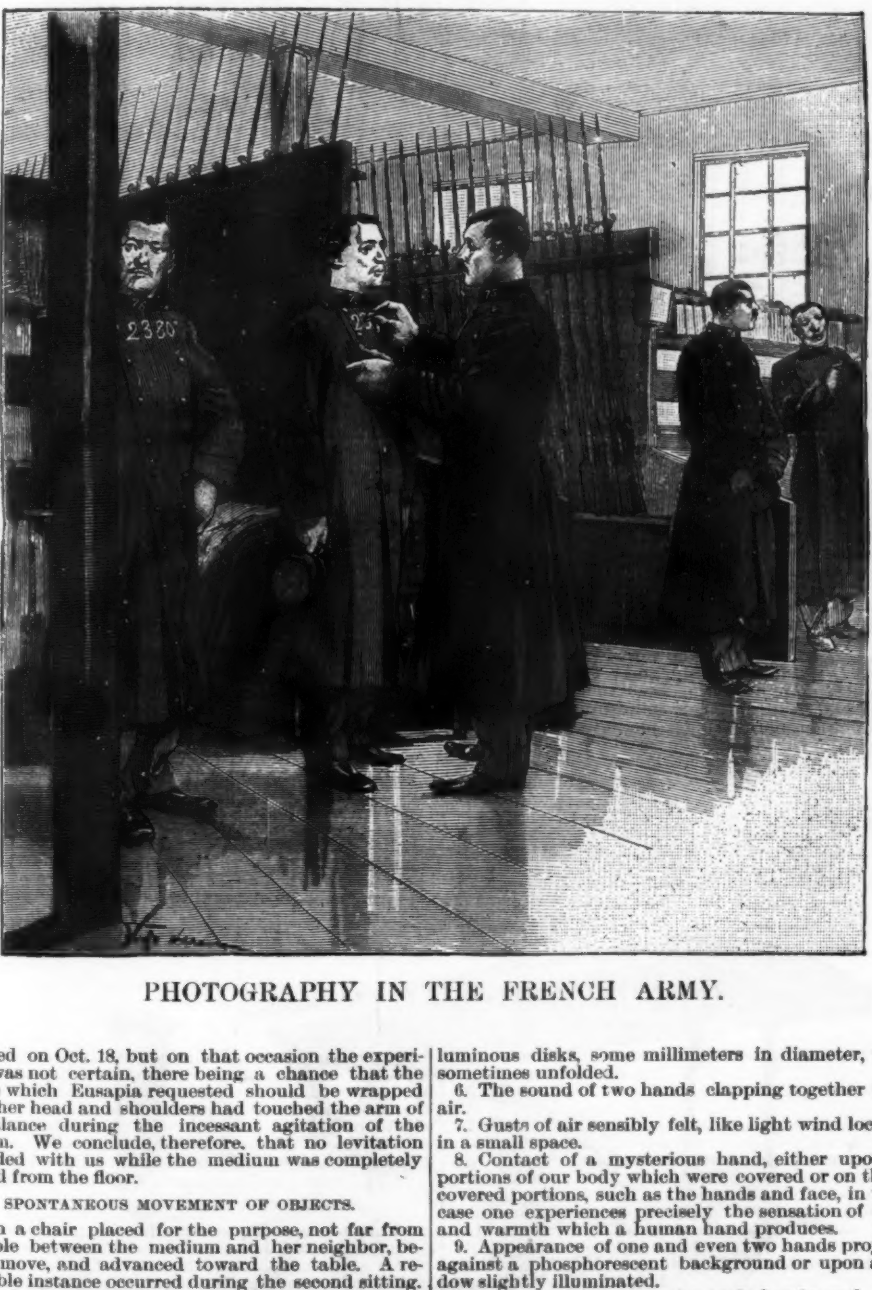
After having noted the influence that the body of the medium exerted upon the scales while seated on it, it was interesting to see if this could be effected while she was at a distance. To that end the scales were placed behind the back of the medium, seated at the table, in such a way that the platform came to within about ten centimeters of the medium's chair. First we placed the hem of her dress in contact with the platform. The steelyard began to move. Prof. Broferio got down upon the floor and held the hem of the dress with his hand, but ascertaining that there was not the least tension, he resumed his seat. The movement of the balance continuing with much force, Prof. Aksakow got down upon the floor behind the medium, took the dress away entirely from the platform, and assured himself with his hands that there was nothing between the platform and her chair, but the steelyard continued to beat violently against the restraining crosspieces. This we all saw and heard.

PHENOMENA OBSERVED IN COMPLETE DARKNESS WHILE ALL WERE SEATED AROUND THE TABLE, FORMING A CHAIN (AT LEAST DURING THE FIRST FEW MINUTES).

The hands and feet of the medium were held by those sitting next her. In this condition of things the most various and singular facts invariably began immediately to present themselves, which, under a full light, we might wish for in vain. Darkness manifestly facilitated these manifestations, which may be classified as follows:

1. Raps on the table much stronger than those which we heard beneath or inside the table when it was light.
2. Knocks and blows given to the chairs of those near the medium; so forcible at times as to turn the chair around, with the person seated in it. At times, the person rising, the chair was taken entirely away.
3. Flying through the air of different objects, such as instruments of music; percussion and sounding of the same.
4. Elevation upon the table of the body of the medium, together with the chair in which she was seated.
5. Apparition of phosphorescent torches of brief duration (a fraction of a second), and of sparks or luminous disks, some millimeters in diameter, which sometimes unfolded.
6. The sound of two hands clapping together in the air.
7. Gusts of air sensibly felt, like light wind localized in a small space.
8. Contact of a mysterious hand, either upon the portions of our body which were covered or on the uncovered portions, such as the hands and face, in which case one experiences precisely the sensation of touch and warmth which a human hand produces.
9. Appearance of one and even two hands projected against a phosphorescent background or upon a window slightly illuminated.
10. Diverse things done by such hands, such as the tying and untying of knots, pencil marks (apparently) left by the same on sheets of paper and in other places, and impressions of such hands on sheets of blackened paper.
11. Contact of our hands with a mysterious face, which certainly was not that of the medium.

Those who deny the possibility of mediumistic phenomena usually explain these facts by the supposition that the medium has the faculty (declared impossible upon the competent authority of Prof. Richet) of seeing in the complete obscurity in which we performed these experiments, and that by artifice she succeeded in making both persons guarding her hold the same hand, thus liberating the other to produce the contact. Those of us who had custody of Eusapia's hands are obliged to confess that she did not conduct herself in a manner to facilitate our work. When an important manifestation was about to take place she began to move about with her whole person, pulling herself away and trying to liberate her hands, especially the right hand, as if from a contaminating touch. In order to maintain control, those holding her were obliged to follow every movement of the hand which wished to escape, and repeatedly, for an instant, the contact of her hand was lost exactly at the moment in which it was most desirable that it should have been maintained. Neither was it always easy to assure ourselves whether it was the right hand of the medium which we held or the left one. For that reason many of the numerous manifestations observed in darkness were considered by us of insufficient demonstrative value, while yet being intrinsically probable. We make no report of such experiments, giving only cases where it was not possible to have the least doubt.



PHOTOGRAPHY IN THE FRENCH ARMY.

ELEVATION OF MEDIUM UPON THE TABLE.

Among the most important and significant facts we put this elevation, which took place on two occasions, on Sept. 28 and on Oct. 3. The medium was seated at one end of the table complaining loudly, as if in pain, when she was lifted bodily with her chair and placed upon the table in exactly the same position as before, and during the whole of the time her hands were held, and accompanied by the hands of those holding them. On the evening of Sept. 28, while the medium's hands were being held by Prof. Richet and Prof. Lombroso she complained of two hands grasping her under the arms; then, in trance, and in a changed voice, habitual to her in that state, she said: "Now I shall lift my medium up on the table." After two or three seconds the chair with the medium seated in it was lifted—not thrown violently, but raised up gently—and placed upon the table, and Signor Richet and Signor Lombroso are sure that they did not assist in raising her in any way.

After a discourse in a state of trance the medium announced her descent, and Signor Finzi having been substituted for Prof. Lombroso, the medium was deposited upon the floor again, with the same ease and precision, while both gentlemen, M. Richet and Signor Finzi, accompanied the movement without in any way assisting it. They observed the motion of her body and hands, and assured themselves as to the position of the hands. During the descent both of them felt repeatedly a hand which touched them gently on the head. On Oct. 3 the same phenomenon was repeated in analogous circumstances. Prof. Du Prel and Signor Finzi holding her.

CONTACT.

Several cases of contact deserve especial notice, because of certain circumstances capable of giving a clew to their possible origin. First of all should be mentioned contact which was felt by persons out of reach of the hand of the medium. Thus, on the evening of October 6 Signor Gerosa, who was seated three places away from the medium (about one yard and a half), she being at one end of the table and Signor Gerosa at the other, having raised his hand to be touched, felt several times a hand seize his to put it down. Persisting in raising his hand, he was struck violently by a trumpet, which was first sounded in the air.

SCHIAPARELLI'S SPECTACLES TAKEN OFF.

In the second place should be noted contact constituting a delicate operation, ordinarily impossible to be accomplished in darkness with the precision with which it was accomplished. On two occasions, Sept. 16 and 21, Signor Schiaparelli had his spectacles taken off and placed before another person at the table. These spectacles are fastened over the ears by means of two elastic springs, and it requires considerable attention to remove them even in the light. Nevertheless, they were removed in complete obscurity with such delicacy and rapidity that Signor Schiaparelli only became aware of it through noticing that the sensation caused by the contact of spectacles with the nose, sides of the head, and ears, had ceased, and he was obliged to feel with his hands to be sure they were really not in their usual place.

CONTACT OF A HUMAN FACE.

One of us having expressed a desire to be kissed, felt before his mouth the quick sound of a kiss, unaccompanied, however, by the contact of lips. This happened on two occasions. On three occasions it occurred to one of those present to touch a human face having hair and a beard. The feeling of the flesh was precisely like that of a living man's face. The hair was much coarser than that of the medium and bristly. On the other hand, the beard seemed to be very fine.

NO LUCK WITH A FOURTH DIMENSION OF SPACE.

The celebrated experiments are well known by which the astronomer Zollner tried to give a proof of the real existence of a fourth dimension of space. Although we knew very well that, according to the opinion of many, Zollner may have been the victim of a mystification, we thought it important to try a number of his experiments. If but one of them had succeeded, under proper precautions, it would have repaid amply the trouble, and would have given a manifest proof of real mediumistic facts. We tried three of his experiments, namely, the linking of two solid rings, of wood or pasteboard, previously separate; the formation of a simple knot in a cord without an end; the penetration of a solid object from the outside to the inside of a locked box, the key of the same to be in the custody of a trustworthy person. None of these succeeded.

PHENOMENA WHICH PREVIOUSLY HAD OCCURRED ONLY IN DARKNESS OBTAINED IN THE LIGHT WITH THE MEDIUM IN FULL SIGHT.

In order to arrive at a full conviction it only remained to obtain the most important phenomena, which had taken place in darkness, in such a way that we should not lose sight of the medium. As darkness is so favorable, as it seems, to the production of such phenomena, it was best to arrange the light in such a way that a small portion of the room should be in darkness, while we and the medium should be illuminated. Accordingly on the evening of October 6, we proceeded in the following manner: One part of the room was separated from the rest by means of a divided curtain in order to leave one portion in darkness, and the medium was seated in a chair before the place of division, her arms, hands, face, and feet being in the lighted portion of the room. Behind the curtain a small chair was placed, with a bell, at a distance of about a half a meter from the medium, and upon another chair fur-

ther away was placed a basin filled with damp clay having a perfectly smooth surface.

In the lighted portion of the room we formed a circle around a table in front of the medium. Her hands during the time were held by those seated next to her, Signor Schiaparelli and Dr. Du Prel. The room was lighted by a lantern with a red glass, placed upon another table. It was the first time that the medium had ever been subjected to this test.

Soon the phenomena began. By the light of a candle not having a red glass over it, we saw the curtain puff out toward us. Those near the medium, placing their hands upon the curtain, felt resistance to their touch. The chair of one of them was pulled violently; then five loud raps were heard on it, which is the number signifying a request for less light. At this we put out the candle and lighted the lantern instead. It was covered partly with a shade, but soon afterward we were able to remove the shade, and, indeed, we placed the lantern on the table in front of the medium.

The edges of the opening of the curtain were fastened to the corners of the table, and folded and pinned over the head of the medium, according to her request. Prof. Aksakow, rising, placed his hand within the opening of the curtain, above the head of the medium, and informed us soon that he felt his hand touched repeatedly by fingers. Then his hand was seized and pulled inside of the curtain, and he felt that something was pushed into his hand; it was the small chair. Then the chair was taken from him and fell upon the floor.

All those present placed their hands within the opening, and felt the touch of hands. In the dark opening above the medium's head the bluish sparks appeared again and again.

A GREAT ASTRONOMER BELABORED.

Signor Schiaparelli was struck forcibly through the curtain on the back and side; his head was covered by the curtain and pulled inside it into the darkness, while his left hand was holding the hand of the medium and his right hand was still held by Signor Finzi. In this position he felt the touch of warm, damp fingers, and saw the sparks describing curves in the air and partially lighting up the hand or the body bearing them. Then he resumed his former position, when a hand appeared at the opening quite distinctly. The medium never having seen this before, lifted her head to look at it, and soon the hand began touching her face. Dr. Du Prel, without releasing the hand of the medium, put his head within the curtain above the head of the medium, and immediately felt his hand touched in several places by fingers. Between his head and that of the medium the hand was still seen.

Dr. Du Prel resumed his place at the table, and Professor Aksakow placed a pencil at the aperture. The pencil was taken by the hand, and soon afterward was thrown out through the curtain upon the table. Once a closed fist appeared upon the head of the medium; it opened slowly and showed us the palm with the fingers separated.

It is impossible to tell the number of times that this hand appeared and was touched by us; it is enough to say that doubt was no longer possible; it was really a human hand that we saw and touched, while the body and arms of the medium remained in sight, and her hands were held by those next her.

After the sitting Dr. Du Prel was the first to pass into the darkened space, and he announced that there was an impression in the clay. We found in it a deep mark of five fingers of a right hand. This was a lasting proof that we had been the victims of no hallucination.

CONCLUSIONS.

In making public this brief and incomplete account of our experiences, we must again express our convictions, namely:

1. That, in the circumstances given, none of the manifestations obtained in a more or less intense light could have been produced by any artifice whatever.

2. That the same conviction can be affirmed in regard to the greater number of the phenomena taking place in darkness.

For the rest, we recognize that from a strictly scientific point of view our experiments still leave much to be desired. They were undertaken without the possibility of our knowing what we should need, and the instruments and different appliances which we were obliged to use had to be improvised. Nevertheless, that which we have seen and verified is sufficient in our eyes to prove that these phenomena are most worthy of scientific attention. We consider it our duty to express publicly our esteem for and our gratitude to Signor Ercole Chiajia for having pursued for so many years with such zeal and so much patience, in spite of opposition and protest, the development of the mediumistic faculties of this remarkable subject, calling the attention of the studious to her, having but one object in view, the triumph of an unpopular truth.

GIOVANNI SCHIAPARELLI, Director of the Astronomical Observatory, Milan.

CARL DU PREL, Doctor of Philosophy, Munich.

ANGELO BROFFERIO, Professor of Physics in the Royal School of Agriculture, Portici.

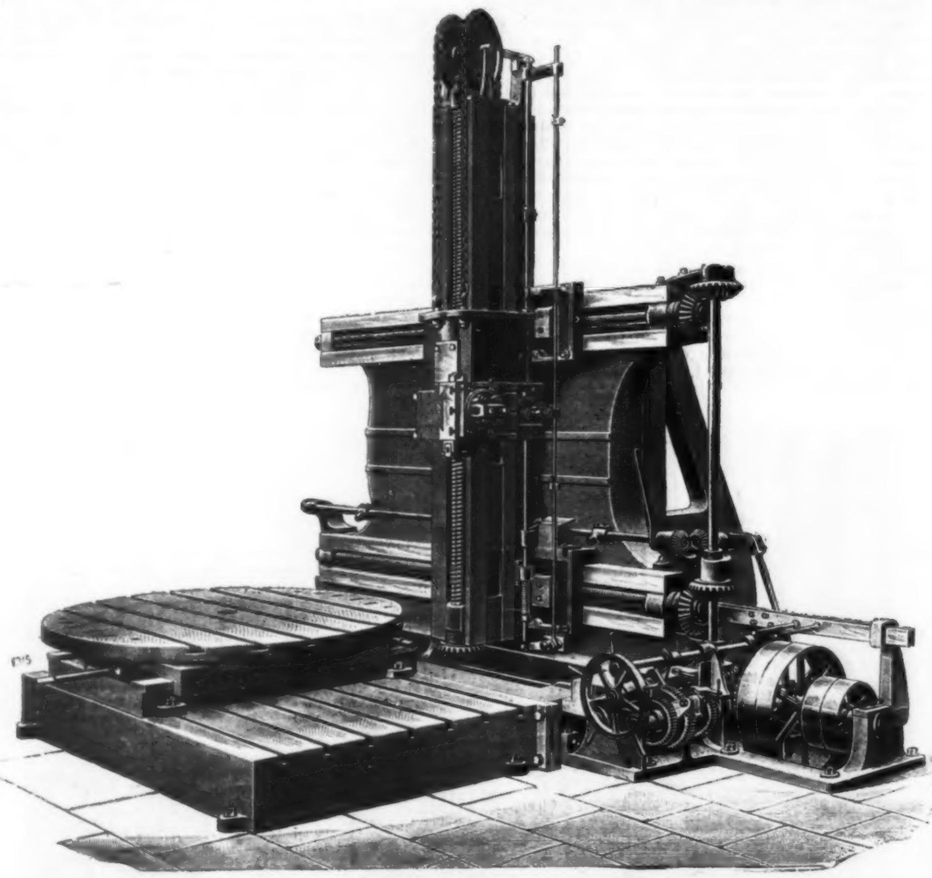
G. B. ERMACORA, Doctor of Physics.

GIORGIO FINZI, Doctor of Physics.

At some of the sittings, of course others were present, as the text shows, among them Charles Richet, Professor of Medicine and editor of the *Revue Scientifique*, and Cesare Lombroso, Professor of Medicine, Turin.

VERTICAL AND HORIZONTAL PLANING MACHINE.

WE illustrate a new vertical and horizontal planing machine, designed and built by Messrs. Sharp, Stewart & Co., Limited, Atlas Works, Glasgow, for the use of marine engineers and others who have to machine castings too large for ordinary planing machines to take in. The machine consists of a heavy bedplate of box section forming the work table, and carrying, when desired, a set of compound slides and circular table, as shown in the engraving, the motions of which can be made self-acting when desired. At one end of the bedplate are the standards carrying the tool slides, etc., and the driving gears. For horizontal planing the vertical column shown in the engraving, which carries the tool, is driven by two horizontal screws connected by bevel gears. In vertical planing the tool is traversed up and down this column by a vertical screw, driven by bevel gearing below. The driving nuts which run on these screws are very long, and completely envelop the screws, thus having ample wearing surfaces. The tool saddle is balanced by a weight inside the column, supported by vertical chains.



VERTICAL AND HORIZONTAL PLANING MACHINE.

Automatic and hand feeds are provided both to the saddle and column. The driving is effected through two sets of pulleys, the smaller giving the quick return motion after the cut, and the belts are so arranged that one belt leaves the fast pulley before the other begins to drive, and by this means the wear of the belts is considerably reduced and their life prolonged. The change of driving from vertical to horizontal can be effected instantaneously, and *vice versa*, the feeds being also changed at the same time. The arrangements are such that it is impossible for the driving gear of either motion to be put into action until the feed gear of the other motion is thrown out, and thus all risk of breaking the machine is avoided.—*Engineering.*

IMPROVED COMPOUND ROAD LOCOMOTIVE.

AT the recent Smithfield Agricultural Show, England, Messrs. Charles Burrell & Sons, Limited, Thetford, had on view a six horse power light compound agricultural engine, the "Devonshire" single crank compound traction engine, and the road locomotive here illustrated, which is suitable for the heaviest description of road haulage. This is a compound engine designed to obviate all noise caused by the emission of exhaust steam up the chimney, which tends to frighten horses upon the roads. The details throughout the engine are stronger than usual, and the gearing is also extra strong, unusually large bearing surfaces being given so as to reduce wear and tear to a minimum. The engine is fitted with large driving wheels, an extra tank under the barrel of the boiler, winding drum, steel rope, injector, water lifter, awning over driver, coal rack, and a complete outfit, so as to be thoroughly equipped for the road in all weathers.

THE GERMAN DISPATCH BOAT HOHENZOLLERN.

THE German navy has long needed a vessel large enough to carry the emperor and his suite in case he should take command of the fleet, to serve as an advice boat in time of war, and capable of being used by the emperor and empress with their retinue, for long voyages. As the imperial yacht Hohenzollern has proved wholly inadequate for those purposes, accommodating only the most indispensable members of the emperor's suite, an appropriation was granted by the Reichstag and orders were given for the construction of a new advice boat that should fulfill the above mentioned requirements as well as those of modern times, in regard

IMPROVED COMPOUND ROAD LOCOMOTIVE.

to speed and size. On June 27, 1892, the vessel was launched at the docks of the Vulcan Company, at Grabow, near Stettin, and was christened Hohenzollern, by the emperor. The name of the old yacht was changed to Kaiseradler.

The plans for the new dispatch boat were drawn in the naval department, by Chief Naval Constructor, Geh. Admiralitatsrath Dietrich. The principal dimensions of the vessel are: Total length, 370 ft.; greatest width, 45 ft.; depth, 33 ft. The displacement, with an average draught of 18 ft., is about 4,200 tons.

The two three-cylinder, triple expansion, compound engines indicate 9,000 horse power, and will propel the vessel at a speed of 20 knots. In each of the boiler rooms there are two single and two double cylinder boilers, 12 boilers in all, worked with a pressure of 12 atmospheres. The bunkers carry a supply of 450 tons of coal. There are two enormous smokestacks of elliptical cross section. As the vessel is not a battle ship, the armament consists only of three rapid-firing guns of light caliber, two of which are placed well forward on the sides, in turrets, and the third is at the stern. Besides these, there are eight guns for firing salutes. In case of war the armament can be increased.

There are two decks for state rooms, etc., below the upper or main deck, and on the latter the large dining room, 52 ft. long, and lighted by 12 windows, and the necessary serving rooms. The roof of this saloon answers for a promenade deck, in the middle of which a little smoking room is built, while on the sides are little niche-like structures that offer comparative shelter in stormy weather. For reconnoitering the surroundings at night, two electric search lights are arranged on the forward part of the promenade deck, and above these rises the commander's bridge, on which a little house has been erected to be used as a lookout. Three steel masts serve for signaling and sailing purposes.

are the engines and boilers, and also the rooms for storing food and water for the crew.

Besides the large engines for propelling the vessel, there are 30 auxiliary machines. The crew is to consist of 260 men.

The Reichstag granted an appropriation of $1,890,-756 for the construction of the Hohenzollern. It will probably be ready for service next summer, making an important addition to the fleet of German war vessels. —*Illustrirte Zeitung.*

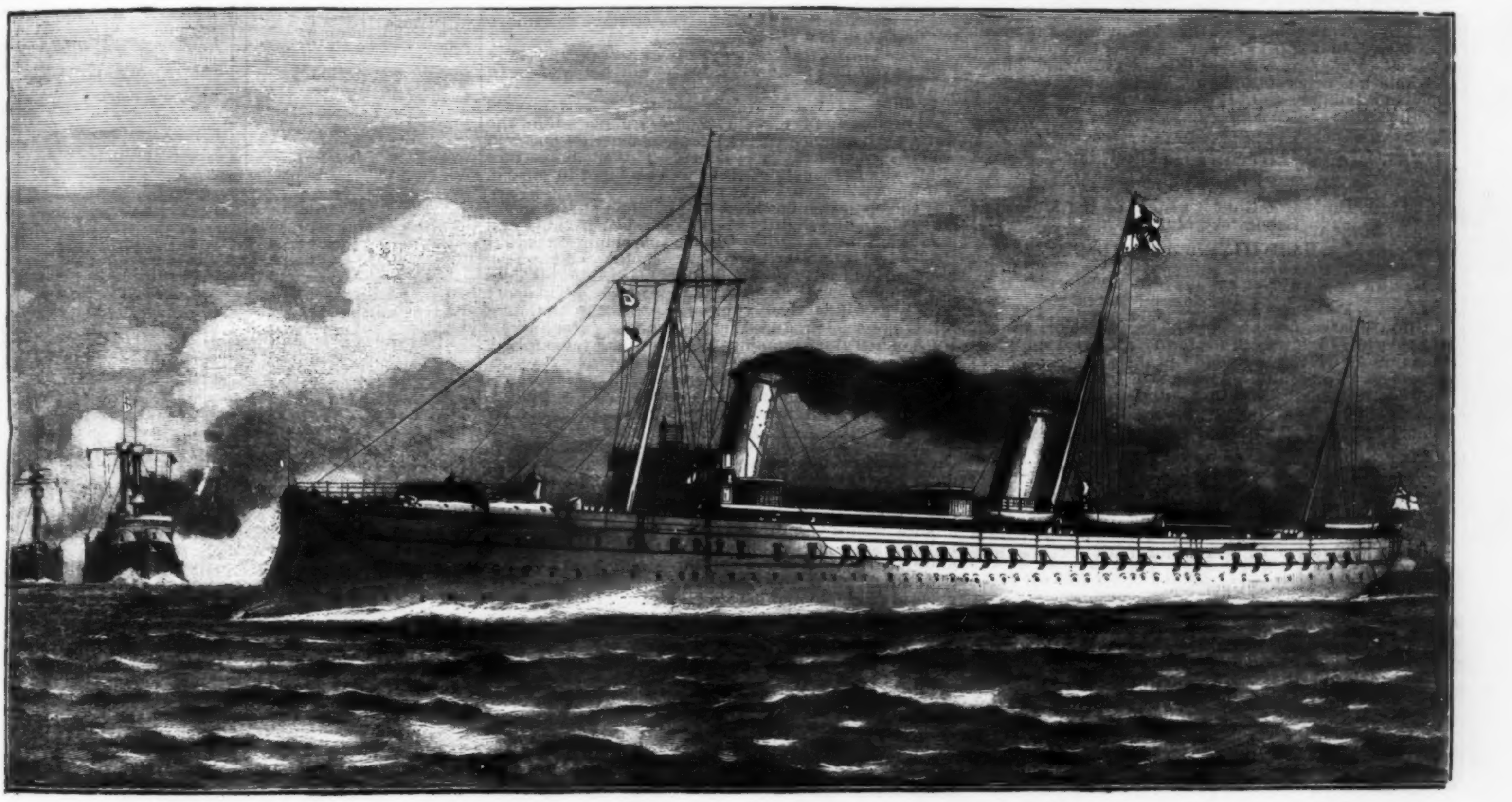
MEAT CANNING IN SOUTH AMERICA.

THE pampas of the River Platte, of the Argentine Republic, Uruguay, etc., have long since become known to all the world through their immense herds of cattle and sheep. While both the wool and the flesh of the latter have poured in immense quantities into foreign ports—fresh mutton into England especially—the slaughter of cattle had for many years been made for their hides and bones alone. The wastage of the flesh has in past years been appalling; nevertheless, it is only of recent years that any serious effort has been made to utilize it. Large meat extract works have been erected to utilize this waste, and still later canning works have been built—a promising enterprise, if we remember that (strange as it may seem) a considerable part of American exports to that country have been of canned food products of every kind, meats included. One reason for this anomaly may, perhaps, be cited in the fact that the pamperos have paid but little attention to their herds. The animals have run wild, so to speak, and their quality as meat has been very poor. Still, very recently, a movement was begun to remedy all this, which will eventually bring enormous wealth to this southern republic; nevertheless, the movement has already so far improved the quality

small knife, the lassoer severs the spinal cord at the base of the skull. Death is instantaneous. The lasso is cast off and the beast is hoisted up to the plaza, or killing floor proper. Here the Spaniards have an opportunity for showing their dexterity in handling a knife. The animal is flayed on the floor, and the hide spread out with the carcass lying on it; they then strip the flesh from the bones, and in less time almost than we can tell it, the flesh is hung up to cool on long rails, and a perfectly bare skeleton is all that remains on the outstretched hide.

The killing floor is about 100 × 300 feet in size—ample to accommodate 1,200 cattle and 3,000 sheep daily. The meat is taken from the killing floor to the chill rooms, which are on the same floor, and open, at one end, on the killing floor, and, at the other, on the cutting floor. There are six chill rooms, each forty-eight feet wide by 160 feet long. They are well constructed, and are piped with 1¼ inch extra strong pipes in a pipe chamber overhead. The pipe is welded in place into coils of 1,200 feet in length for the direct expansion of ammonia. The expansion valves are located on the walls near the doors, and every precaution taken to make the rooms as easy to handle as possible. The rooms throughout the building are all insulated by air spaces and the American Standard Paint Co.'s P. & B. insulating paper.

From the chill room the meat passes through a cutting machine, which will cut up as much meat into suitable size for canning as 300 men could by hand, and forces it automatically through a chute into the pickle rooms below. These rooms are situated directly below the chill rooms, and are also supplied with endless coils of 1¼ inch ammonia pipe. Here the meat is kept in pickle at an even temperature of 38° for from fourteen to seventeen days. It is then loaded on iron trucks and taken up by a hydraulic elevator to the



THE GERMAN DISPATCH BOAT HOHENZOLLERN.

The eight small boats hanging in davits along the sides of the vessel can be used for communication with the shore or for life-saving purposes.

The most important rooms are on the first middle deck, just below the upper deck. Starting from the stern, we come first to the offices and the secretary's room, and these are followed by rooms for those in charge of the empress' wardrobe the stewardesses, and by the pantries and bath rooms. Farther forward are state rooms and bath rooms for the suite, and the ladies' saloon, while about in the center of the vessel are the apartments of the emperor and empress, arranged on opposite sides of a passageway, and consisting of sleeping, dressing, and bath rooms, besides the emperor's work and audience rooms and the empress' sitting room. Next to these is the general saloon, and forward of that the rooms of the young princes. On the forward part of this deck are rooms for some of the officers and crew, and beyond the princes' rooms are the mess room and living room of the commander and officers. After these are some rooms for the crew, while the hospital and apothecary's shop occupy the foremost part of the vessel.

On the second middle deck are rooms for the servants, for the emperor's wardrobe, baggage rooms, the imperial galley, etc., as well as saloons for the deck officers and crew, and the necessary bath rooms, laundries, drying rooms, and the officers' cuddy.

On the platform deck, under the first middle deck, are the baggage rooms for the imperial suite and the servants, and also the wine room. A steam heater and three dynamo-electric machines are located on this deck, for supplying heat and light for all the rooms, and besides these there is a secondary battery to be used in case the dynamos should cease to work during the night on account of the stopping of the engines. Two distilling apparatus, also on this deck, supply fresh drinking water, and there is a refrigerator for the preservation of meat and other food. In the hold

of the beef as to warrant the erection of the great canning works of the Highland Scot Canning Co.

These works are situated on the Buenos Ayres and Eusenda railway, about half way between the stations of Espeleta and Berazategui. The main building is 468 × 288 feet, with an extension 260 × 170 feet on the east side, all three stories high, and were designed by Edbrooke & Burnham, architects, of Chicago. The walls are built of native brick, made at Berazategui and Quilmes. These brick are of peculiar make, being 12 × 6 × 1½ inches in dimensions, and are rougher and uglier than it would seem possible for mortal man to make them intentionally. They are made thin on account of the scarcity of fuel for burning, and being of large area, are liable to be bent into almost any shape before and during the burning. They would give the American brickmaker or mason the "shakes." All the heavy timber used for columns, girders and joists was shipped direct from Mobile, Ala., while the flooring and sheeting for the insulation were imported from Norway, and the sash, doors and roof trusses was made in England. The plant is equipped with the best modern and improved machinery in all its various departments, in providing which foreign lands figure as numerously as they did in the materials in the building itself.

The cattle corrals are located at the north end of the building; and here the animals are killed in true Argentine style. These corrals are made in triangular, or, rather, pear shape, with the narrow end toward the building. Just inside the wall of the building is placed a powerful winch for serving the lassos, which pass through the side of the building into the corrals. The lassoer stands on a platform outside the corral, and throws the lasso, and when the animal is caught, he gives the word to the man at the winch. The lasso is then drawn in and the animal drawn up till its face is held firmly against the building. It is perfectly helpless now, and with one dexterous thrust of his

cooking room, which is on the third story. Here it is partly cooked and passes on to the canning room.

The canning room is almost 160 feet square, and is about as busy a place as one would wish to see. The meat comes down five chutes from the cooking room, and at each chute is a weighing table where the meat is weighed and passed into the canning machines. There are five of these machines, built by the Hercules Iron Works, Chicago, each of them capable of filling from 10,000 to 14,000 cans per day. From the canning machines the meat is passed on to the capping tables, and then to the retorts, where it is processed, sealed and delivered to the cooling and washing rooms on the floor below. Before leaving the third story again, we must mention the tin shop, which is 128 feet wide by 160 feet long, and located alongside of the canning department. It is fitted up in the most approved manner by G. A. Crosby & Co., Chicago, and is capable of turning out 60,000 cans per day.

In the south end of the second floor are the washing, painting and labeling rooms; and north of them is the box making shop. This is a most interesting department, as all the boxes are made by machinery, five American nailing machines driving every nail in the boxes and covers. On this floor there is a 25 ton ice tank, built by the Hercules Iron Works, Chicago. It is very conveniently located along the west wall of the building, overlooking the track where the refrigerator cars are loaded, the ice being drawn directly from the tanks and shot down a chute into the top of the cars. Passing northward till we pass through the pickle rooms, we come to the oleo department, 100 feet wide by 300 feet long, fitted with Boomer presses and all the latest improvements for making butterine and oleomargarine.

Descending to the ground floor we find, below the oleo room, the hide room, and, south of this, below the pickle rooms, are the freezing and cold storage rooms. There are nine freezing rooms, each sixteen

feet by thirty-two feet, piped with 1¼ inch ammonia pipes. These rooms are very heavily piped and can be maintained at a temperature of from zero to four below. They open into a frozen deposit, 144 × 160 feet, which is maintained at a temperature of from 12° to 16°. The choice cuts of the meat are placed in the freezing rooms for forty-eight hours, when they are frozen perfectly solid, and then boxed and stored in the large deposit until sufficient has been accumulated for a shipment. On this floor there are also two large cold storage rooms, each 64 × 160 feet in size, which are maintained at 38°.

The engine room is situated on the east of the main building. Everything here has been provided in duplicate to provide against accident. Two 250 horse power Corliss engines of English design furnish power for the house and drive the dynamos. There are four dynamos, built by Holmes, of Newcastle-on-Tyne, each capable of furnishing 1,000 incandescent lamps. Two 120 ton refrigerating machines, built by the Hercules Iron Works, of Chicago, supply the refrigeration for this great plant, and stand in this room. This is probably one of the largest direct expansion plants ever erected at one time and under one roof for a packing house, but it has been so carefully worked out in all its details that it can be handled with perfect ease by the engineer on watch. Steam is furnished by two batteries of boilers located north of the engine room. One battery is composed of five 250 horse power marine boilers, the other of three 300 horse power Galloway boilers. At the end of the boiler room is located the machine shop, blacksmith shop and foundry, where all the repair work of the factory is done.

This plant is one of the most important in the republic, furnishing employment for over 3,000 men and boys. The company had to build a town for its employes, which they provided with all the modern improvements, such as electric light, hotel, school, church, not even forgetting a strong, commodious jail. They manufacture all kinds of canned and preserved meats, including all fancy brands, also a brand of beef extract, in which it bids fair to rival the Liebig fabric at Frie Bentos. They own a fleet of five steel steamers, which are kept busy carrying manufactured goods to Liverpool and London, and bringing out supplies and coal for the fabric at Espeleta.—*Ice and Refrigeration.*

THE MANUFACTURE OF LIQUORS AND PRESERVES.*

By J. DE BREVANS, Chief Chemist of the Municipal Laboratory of Paris.

PART III.—CHAPTER II.

Fruit Preserves.

Apricots.

CHOOSE large, fine apricots of a good color, whiten them as already directed for brandied apricots. Wash them in fresh water and drain on a sieve, or more properly, on a napkin. Arrange the fruit in the jar so as to make it hold the largest number of pieces without crowding. Fill the jars with white cold sirup at 26°. Fasten the cover, or wire down, put in a water bath and boil for three minutes.

Pineapples.

Cut off the ends and pare the pineapple, cut in slices, fill the bottles or jars to about two-thirds, then fill with cold white sirup at 15°. Fasten on the covers tightly, heat to 100° C. in a water bath for one half hour.

Cherries.

Use fine cherries, not too ripe, without spots or bruised pieces. Cut off the stems so as to leave only about 1 centimeter (one third inch). Fill the bottles with the fruit, using great care, and cover with cold white sirup at 24°. After bottling, cork tightly, put on a water bath and boil for twenty minutes.

Strawberries.

The strawberry (*Fragaria vesca*, L.) is an indigenous plant growing wild in the woods. There are numerous varieties which are obtained by cultivation.

. . . .

Strawberry preserve is made as follows: Take the good fruit ripe and gather in dry weather. After having been hulled, they are placed in bottles which are filled with a cold sirup of 28°. After bottling, cork, wire down and carry the bottles to the boiling point and allow them to boil for some minutes over a water bath.

Raspberries.

The raspberry (*Rubis idens*, L.) like the strawberry, grows spontaneously in forests. The raspberry is exceedingly delicate and requires great care in preserving, which is done in the following manner: Take the fruit before it is completely ripe, hull and pack in bottles or jars so as not to crowd, but still fill the jar to its greatest capacity. Fill with cold sirup at 26°. Boil for some minutes on a water bath.

Currants.

The currant (*Ribes*, L.) comprises three kinds:
1. The red currant (*Ribes rubrum*, L.)
2. The prickly currant (*Ribes uva-crispa*, L.)
3. The black currant (*Ribes nigrum*, L.)

The first two grow naturally in the woods and hedges, but their fruit possesses no perfume.

Currants are preserved in the following manner: Take fine red or white currants, remove from the bunch and place in bottles. Then add the cold sirup at 36° and boil once.

Chestnuts.

Take fine chestnuts which have been treated three times with sugar and fill the bottles and add cold sirup at 32 and boil for three minutes.

Walnuts.

Walnuts are prepared in the same manner as chestnuts, only they are boiled five minutes.

Peaches.

Peaches are prepared in the same manner as apricots.

* Continued from page 14317, SUPPLEMENT, No. 896.

Pears.

Whiten the pears and drain. Give them four baths in the sugar and fill with a cold sirup of 28° and boil for eight minutes.

Plums.

The first step in the process is the same as for brandied plums. When the prunes are whitened, cooled and drained they are placed in bottles with sirup of 28°. Cork, wire, and boil for five minutes.

CHAPTER III.

Preservation of Fruits by the Appert Process.

The principle of the Appert process of preserving fruits is based on the destruction by heat of the ferments and the germs which are inclosed in them. This process might also be called sterilizing fruits.

The process is worked as follows:

1. Shut up the bottles or other vessels with the fruit in them.
2. Seal the bottles up tightly.
3. Submit the bottles to the action of boiling water in the water bath for a length of time depending on the substance.

The success of the operation depends in a great measure on the following:

1. In the choice of bottles, which must be in good condition.
2. The finest corks should be used.
3. They must be corked with the greatest care, the cork being fastened with wire or in the same manner as champagne bottles.
4. The bottles or jars are enveloped in linen or placed in bags made expressly for the purpose.
5. The vessel in which they are placed is filled with water and maintained at 60° without boiling, to prevent evaporation, which would require a new supply to be added.
6. It is better to draw off the water than to remove the bottles to cool them.
7. The bottles are then sealed with wax and may then be put in a place where they will be exposed to the air.

An important improvement in the Appert process was produced in 1839. The jars are placed in the water bath and are covered with a metallic cover in which a small hole is punched. This small aperture allows the last traces of air as well as vapor to escape. A drop of solder closes the orifice.

If the operation has been well conducted, the metal cover should be slightly bulged out, even if the small hole is left, but a no less dispensable condition is that this convexity must disappear on cooling and a pronounced concavity should take its place. If this does not happen, use the contents immediately. This convexity, as will be readily understood, is due to the internal pressure produced by the vapor of water and the trace of air which remains. When cooling takes place, these vapors are condensed and the interior pressure becomes less than the exterior, hence the concavity. If the convexity continue, it is certain that the internal pressure is produced by some other substance besides the vapor of water.

When after several days, or even sometimes months, the top is swelled up to any great extent the phenomenon is the sign of a deep alteration in the preserves, which have been improperly sterilized, or, in other words, the fruit ferments. M. Gannal has given a sure means of guaranteeing the product. It is to maintain a moderate temperature in a stove for a month after preserving. If the swelling of the top does not occur, it is very certain it will not do so. The general method having been given, it will be necessary to indicate the modifications in the process which the various fruits make necessary.

Preserved Apricots.

Ripe fruit is preferred, but still only fruit should be chosen which offers a certain resistance. The pit is removed as well as the skin, which allows some chance for fermentation. The apricots are introduced in bottles provided with large mouths, so as to hold as many as possible without crowding. Cork tightly and place in the water bath. After boiling once, allow the bottles to cool. Then place the bottles in a cool place.

Pineapple Preserves.

For a number of years the manufacture of pineapple preserve has obtained considerable development in the countries where the fruit is grown. As it is difficult to obtain bottles of the right shape to preserve an entire pineapple, as well as the trouble in transporting, tin cans are extensively used. Pineapples, owing to relative volume, must be heated for a long time.

Cherry Preserves.

Cherries are introduced entire in glass vessels and piled up gently. They are heated for a few minutes, but much less than apricots.

Raspberry Preserves.

Raspberries are preserved in the same manner as currants, but it is a very difficult operation, which must be conducted with care to obtain the best results.

Currant Preserves.

Currants may be preserved by the Appert process for a year or more, but if the aroma and the odor remain intact, the same is not true of the form, which is sacrificed if extraordinary precautions are not taken. Currants, after having been separated from the stem, are introduced in bottles so as to leave as little air space as possible. Cork tightly and heat on a water bath, as has been already described.

Peach Preserves.

It is very difficult to preserve peaches so as to preserve their form, this fruit being very delicate. The variety of peach is chosen which has the most aroma. They are preserved at their maturity without being too ripe. They are cut in two to remove the stone and are in turn redivided if necessary. They are piled as tightly as possible, some almonds are added and the bottle is tightly corked and put on a water bath, and is put in bottles and given one or two boilings. Remove the fire from the water bath and allow it to cool. When the water is cold remove the bottles and put in a place which has a good circulation of air, but not too damp.

Other fruits are preserved in this general manner, the time of heating depending upon the size of the fruit and the difficulty or ease with which it can be sterilized.

PART IV.—ANALYSIS AND ADULTERATIONS.

CHAPTER I.

Analysis of Alcohols and Liquors.

SECTION I.—ALCOHOL.

In pure alcohol two elements must be determined:

1.—The quantity of absolute alcohol contained in the liquid, that is to say, the alcoholic degree.

2.—The purity of the product, that is to say, if the alcohol is only a mixture of ethyl alcohol and water, or if it contains aldehyde and the superior alcohols—amylic, propylic, butyric, etc.

Determination of the Alcoholic Strength.—This operation is very simple and is made by means of the centesimal alcoholometer of Gay-Lussac (Fig. 56), the

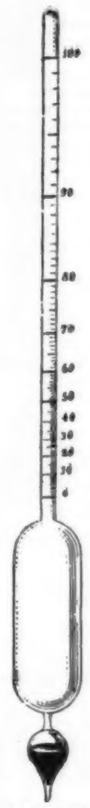


FIG. 56.—ALCOHOLOMETER OF GAY-LUSSAC.

use of which has become obligatory in France by the law of July 8, 1881, put in effect by the decree of December 27, 1884. It is a densimeter of constant weight, graduated so as to obtain the richness in alcohol of mixtures of alcohol and water, provided it contains no other material. The alcohol to be tested is placed in a high jar, the alcoholometer is placed in it, and when equilibrium has been attained the graduation corresponding to the lowest part of the meniscus is read.

(*To be continued.*)

THE EFFECTS OF COLD ON SUGAR MAKING.

WE, in Louisiana, have certainly much yet to learn in respect to the effect of freezing weather on sugar cane. As stated in a recent issue of the *Planter*, on a plantation where the temperature fell to 23° Fahrenheit on the morning of December 27, and ice was formed during the succeeding two nights, the stalks of cane were not burst open in any instance observed, but there was a noticeable exudation of cane juice from the eyes of the cane, indicating the rupture of the cells adjacent thereto. There was no scientific examination of this cane made, but ordinary observation showed that the canes began at once to present a different appearance when split open for examination.

The usual white or whitish appearance of the cane throughout was daily giving place to a gray or darker color near the surface, and this in some instances affected the whole cane. Immediately after freezing, the softer top end part of the canes manifested the greatest injury, and within a few days some of the canes, upon which too much of the top was left, were found slightly off in flavor at the top. On January 5, nine days after the freeze, there was a perceptibly pungent odor in the bagasse, and this seemed to increase during the following two days, when the grinding was finished. The last of the canes, frozen on December 27, as stated, were ground on January 7, and with no seeming difficulty in the process of manufacture, excepting a gradually increased quantity of lime having been required, and with some slight difficulty in procuring rapid settling the last two days of the campaign, and with some difficulty in filtering the scums through the filter presses during these two days. The sirup worked as well as usual and was concentrated into sugar without difficulty, seeming to have given the usual yield.

Without any chemical control, still daily polarizations were made of the juice made daily. The canes were of various kinds, and the juice of varying dilution, and therefore its density became no indication of its merit. The juice was carefully measured in tanks holding the juice from about three tons of cane, 3

sample being taken from each measuring tank and the accumulated daily sample being polarized. The following table shows the calculated purity of the juice thus obtained, and is the result of the entire work of the sugar house during the time given, and amounted to about 200 tons of sugar cane per day, and seemingly without any other cause for the indicated deterioration excepting that of the freeze:

PURITY OF JUICE.

December	25	83·0
"	27	82·0
"	28	81·9
"	29	81·7
"	30	81·5
"	31	81·0
January	1	80·9
"	2	80·7
"	3	80·4
"	4	80·0
"	5	79·6
"	6	77·8
"	7	77·4

It seems a little singular that the deterioration should be so regular and so gradual, and there may have been some error in the samples. If there has been any error, its effect is reduced to a minimum, because, as stated, the general sample polarized was an accumulation of smaller samples taken daily from about seventy tanks measured. The cane ground was all plant cane, part purple cane and part ribbon cane in probably about constant quantities.

Beginning with a purity of 83 per cent. and with a constant diminution, it was not until the purity fell below 80 per cent. that a pungent odor was discovered in the bagasse, and not until it fell below 78 per cent. that any difficulty was found in settling the juice in the clarifiers and in working the scums in the filter presses. It is to be hoped that where careful chemical control has been exercised much valuable information concerning the effects of this freeze will be obtained.—*La. Planter.*

HYDRO-ELECTRIC DISTRIBUTION OF POWER AND ELECTRIC ENERGY.

THE innumerable varieties of the systems of distribution of electric energy now realized or about to be are justified by the extreme diversity of the particular cases that practice meets with.

One of the most characteristic factors of a nature to fix the selection of a system resides in the density of the consumption and in the possibility of establishing the source of production in the very center of consumption. In this particular case, the use of low tensions and of the continuous current becomes necessary, and this is what we now see applied exclusively in Paris, where the density of the consumption is as great as may be desired. If, on the contrary, the consumption is distributed over a wide area, and the generating establishment is very distant from the extreme points of consumption, it is necessary to have recourse to a double line of wires, one for the transportation of energy to a distance and one for distribution. Nothing, moreover, necessitates the use of an identical system for the transportation and distribution wiring. It is often of interest, however, to employ electricity solely, especially under the form of alternating currents, because the apparatus (the transformer) designed to discharge the energy, transported at a high pressure, into the distributing wiring, presents a character of simplicity and economy, and gives an excellent rendering, superior to that of all other apparatus used in the industries. The alternating current transformer is an inert apparatus, that requires no maintenance or surveillance and includes no movable piece. It is possible, likewise, to use continuous currents. The transformer is then either an electric motor that actuates a dynamo or a battery of accumulators. In the first case, we create true mechanical sub-stations that necessitate a maintenance and surveillance, and that do not give so good a rendering as that corresponding to distribution by alternating currents. In the second case, we have the advantage of being able to store up the electric energy produced during a part of the night and day, to defer the utilization and to perform the service with a less important productive *materiel;* but the expense appertaining to the installation of stations of accumulators often offsets the saving made on the producing works, and the small rendering of the accumulators and their rapid extinction enters into account to limit the advantages that seem to result from their use. In practice, the selection to be made is shown by a question of dollars and cents, which is often very complex, and so much the more so in proportion as it is a question of providing for necessities whose nature and importance can be but vaguely appreciated at the time that the project is established. This incertitude would alone suffice to explain the want of success of certain systems, that needed, in order to succeed, only a more judicious application under conditions more favorable for their employment.

In view of the so different functions of the two systems, we may ask ourselves whether, under the conditions that we have just examined, it is not advantageous to have recourse to different systems for the transportation of energy under any form whatever, and to its distribution under an electric form.

We might cite numerous examples in which this is the case. The distribution of compressed air in Paris and that of gas in cities are nothing else but distributions of energy, the first under the form of fluid under pressure and the second under the form of latent thermic energy. Unfortunately, compressed air is a deplorable agent of transportation as regards rendering, and when it is a question of producing high power, the indispensable addition of a reheater makes of the compressed air motor a complex system of irksome maintenance and the advantages of which are but rarely appreciated. The gas motor likewise constitutes a complicated apparatus of delicate management, and which is less convenient and much more cumbersome than an electric motor.

With gas and compressed air, the sub-station becomes a true establishment, comprising a complex *materiel* and an important *personnel.*

The transportation of energy in the form of water under pressure constitutes an intermediate system whose relative simplicity and elegance we have recently had an opportunity of appreciating at Antwerp on visiting Mr. Van Rysselberghe's hydro-electric installation.

The system favored by Mr. Van Rysselberghe is, in principle, as follows: The transportation of energy to a distance by water under pressure, the utilization of it in this form at all points where there is need of mechanical work, and the establishment of sub-stations for the generating of electric energy, for public and private lighting in the very heart of the principal centers of consumption.

The city of Antwerp offered Mr. Van Rysselberghe exceptionally favorable conditions for experimenting with his system of hydro-electric distribution, and the fact must be admitted that he has very ably profited thereby to bring into relief all its advantages and to leave in the background all its inconveniences. The city of Antwerp has for many years possessed a hydraulic works that distributes water under pressure for the maneuvering of the cranes with which its large port is provided. This water is furnished at a pressure of 50 kilogrammes per square centimeter, say about 50 atmospheres. Each cubic meter of water therefore represents a gross power of 500,000 kilogrammes, and, taking into account the performance of the hydraulic motor or turbine utilizing the water under pressure, would furnish an electric energy of 800 watts-hour. The water under pressure produced at the works by means of hydraulic pumps would be distributed by pipes in the city and would supply, in addition to the hydraulic motors, a certain number of sub-stations analogous to the one now established at Verte Place, and that are represented in the accompanying figures. Fig. 1 shows the machinery and Fig. 2 gives a general view of the elegant little pavilion in which it is installed.

The machinery comprises a high-pressure turbine wheel, with a horizontal shaft directly actuating a continuous current dynamo with excitation in derivation. The turbine has a variable admission, so as to regulate the consumption of water according to the electrical production. The superintendent of the station has under his eyes amperemeters and a voltameter which inform him at every instant as to the production of the dynamo, and he regulates the distribution by acting upon the water inlet of the turbine on the one hand and on the excitation rheostat on the other, in order to keep the potential constant.

FIG. 2.—PAVILION CONTAINING THE MACHINERY.

The simplicity of this sub-station is truly captivating, and the demonstration that it has furnished is apparently very conclusive, since it has sufficed to cause the capital to be subscribed that is necessary for the carrying out of the project.

We must confess that we are less convinced. Mr. Van Rysselberghe's system does not seem to us destined to prove as great a success as its promoters hope for, and for the following reasons:

Owing to the progress made by the electric industry, continuous current lines of 500 volts are now no longer anything but a bagatelle, as is proved by the American tramways and the five-wire distribution established at Paris to supply the sector of Vichy Place. The rendering of hydraulic motors is inferior to that of electric ones, and we are as yet reduced to hypotheses as regards that of Mr. Van Rysselberghe's turbine, and that the most hopeful estimates make equal to seventy per cent. Finally, we are beginning to employ electric cranes for the service of ports, and this application can but develop itself, since the types of motors required by this special industry have now been brought to perfection in their smallest details.

Under such circumstances, it seems to us that Mr. Van Rysselberghe has displaced the terms of the problem and taken a step backward in having recourse to hydraulic transportation and electric distribution. We should have preferred to transport at 500 or 600 volts, which is a sufficient potential to reach economically the most distant points of the line, and to branch upon these 500 volts the motors of great power that are to be directly supplied, while the motors of feeble power and the electric lamps would be branched upon bridges of 120 or 125 volts. We should thus have but a single system, while the combination favored by Mr. Van Rysselberghe includes two systems—one of them hydraulic, for the great mechanical powers and the substations, and the other electric, for lighting and for small motors.

The conditions would be entirely different if it were a question of utilizing a works for the production of water under pressure already established for other applications, and the power of which would be, in consequence of unrealized anticipations, much greater than the needs of consumption. In this case, a hydro-electric combination would increase the field of utilization without a corresponding increase of the expenses of installation; but it is not thus at Antwerp, since it is a question of constructing a special works exclusively devoted to the production of water under pressure for the distribution of energy. Upon this point, we are far from sharing the opinion of the learned Belgian, and, despite all the elegance of the solution proposed, the advantages that are to result from it escape us completely.

For want of figures, it would be difficult to discuss the question thoroughly, and after these reservations, we must be content to await two years, as Mr. Van Rysselberghe has invited us to the practical results of the installation that he is preparing and that he hopes to inaugurate in a few months. We willingly accord to Mr. Van Rysselberghe the credit that he claims. Later on, we shall, if there is occasion to, make an apology when experiment shall have pronounced in the last resort.—*E. Hospitalier, in La Nature.*

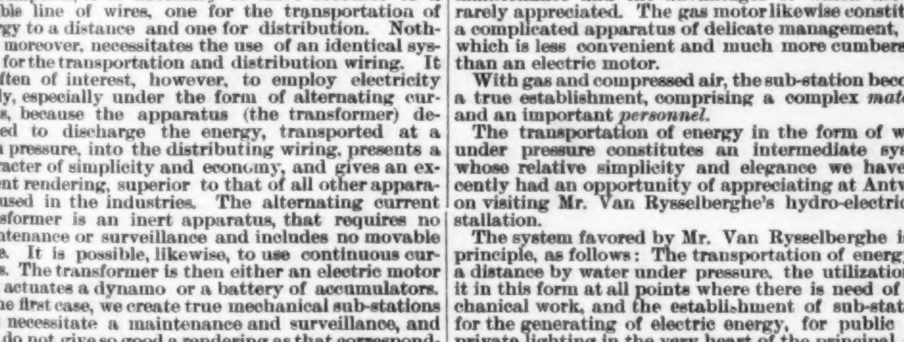


FIG. 1.—HYDRO-ELECTRIC DISTRIBUTION OF POWER AT ANTWERP—THE MACHINERY.

THE TOUR OF SWITZERLAND.

The scenic beauties of Switzerland are so great as to attract thousands of tourists annually, and the authorities of that sturdy little republic do all in their power to encourage the advent of visitors. It is a commercial affair of the greatest importance to the country, for the amount of money yearly brought and spent by the travelers rises to the millions. Among other helps to this annual visitation is the establishment of what are termed general inquiry offices, in different places, where strangers may obtain reliable information concerning the mountain passes, routes, hotels, transportation, and guides, as well as statements of the industries of Switzerland, modes of business, government, etc. In fact, any information desired concerning the country is here to be had free of charge. Complementary pamphlets are also here issued, containing descriptions and pictures of interesting places. From one of these little books we take the following particulars and illustrations:

It matters not at what point the tourist enters Switzerland; at each of its thresholds a scene of beauty awaits him, and, as all roads were once said to lead to Rome, so to-day do all the principal avenues of European travel converge to this Alpine park, nestling high up in the center of the Continent, created by the hand of God, and reserved and improved by the hand of man to form a pleasure ground where in summer all the weary world may find fresh air, rest, recreation, and a scenery unsurpassed.

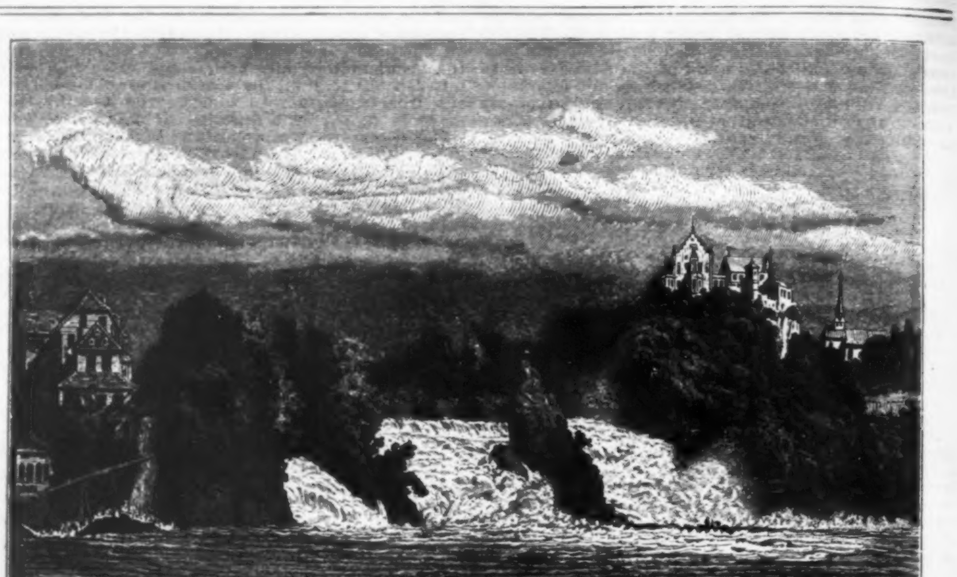
Whether one enters at Schaffhausen, at Lake Constance, or at Buchs from the east, at Chiasso from the south, or at Basle or Geneva from the west, from the first moment of crossing the frontier, its beauties charm and fascinate him. He feels that he has left behind him the dry, commonplace thoroughfares of everyday life, and has entered a fairy land where blue lakes dot the landscape, where snowclad peaks rear their majestic forms against skies as blue as those of Italy, where long vistas of valleys stretch away among chalet-dotted mountain ranges, forming the roadways through which swift mountain streams seek out their long way to the distant sea; where every nook shelters a hamlet, and every hamlet an inn with comfort and good cheer; where modern civilization has joined hands with nature and enterprise to facilitate access by footpath, pike, steamer, and rail to every one of the thousand beauteous points in which this favored land abounds; where, in short, nature stretches out her welcoming hand, and bids all her lovers come and revel in her charms.

THE SANTIS.

Such is Switzerland, the land of tradition, the land of romance, the land of patriotism, the land of Tell, the resort of pleasure seekers, invalids, and travelers since long before the Christian era, and to-day the Mecca of summer wanderers from all parts of the civilized world.

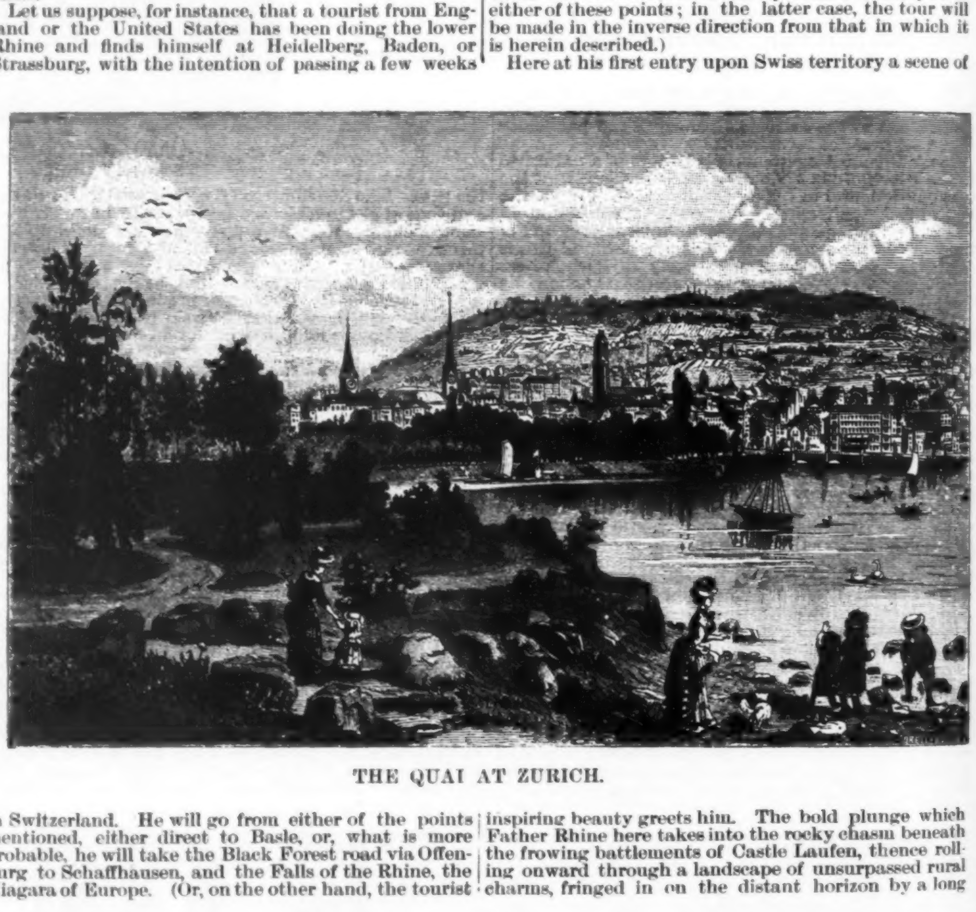
A wondrous bit of mosaic is indeed this little republic, with an area only one third as large as that of the State of New York, and across which one can travel from end to end in the short space of from eight to ten hours. Yet what a teeming land it is! What a combination of natural beauties and artificial improvements meets the eye wherever it turns! Were there ever such hotels and such well kept ones as those of Switzerland? Were there ever elsewhere such mountain roadways reaching far up into the clouds, such wondrous facilities for access to the most sequestered nooks, such utilization of all that science offers to bring into greatest effect the picturesque treasures which nature offers? Did Tell ever dream that a railway would lead to the cloud-covered summit dominating the scene of his exploits at Kussnacht and Immensee? Did Lord Byron, when he commemorated the fortitude of Bonnivard, ever imagine that an electric tramway would some day be conveying visitors to the scene of his hero's trials at Chillon? Did the superstitious monks who once dwelt around Pilatus even conceive it possible that in this year of grace the iron horse would carry loads of passengers far up into its solitary fastnesses? Yet these are but a few of the wonderful pieces of mechanism which to-day astonish the visitor to Switzerland and leave him in doubt which most to admire—the land's natural beauties or the energy and enterprise which man's hand has evinced in turning these beauties to account for the enjoyment and entertainment of mankind.

Now as to the possibility of becoming thoroughly acquainted on a single trip or a single season with all that is beautiful and novel and interesting in Switzerland, it would be well for the visitor to dismiss the idea at once from his mind. One must spend at the very least *three seasons* in the country if he would learn to know it thoroughly from end to end, small as it is. Yet spite of this fact one may in a trip of two or three weeks obtain a very good general idea of the principal localities and routes, leaving the details and the smaller points to be picked up one by one during subsequent visits.



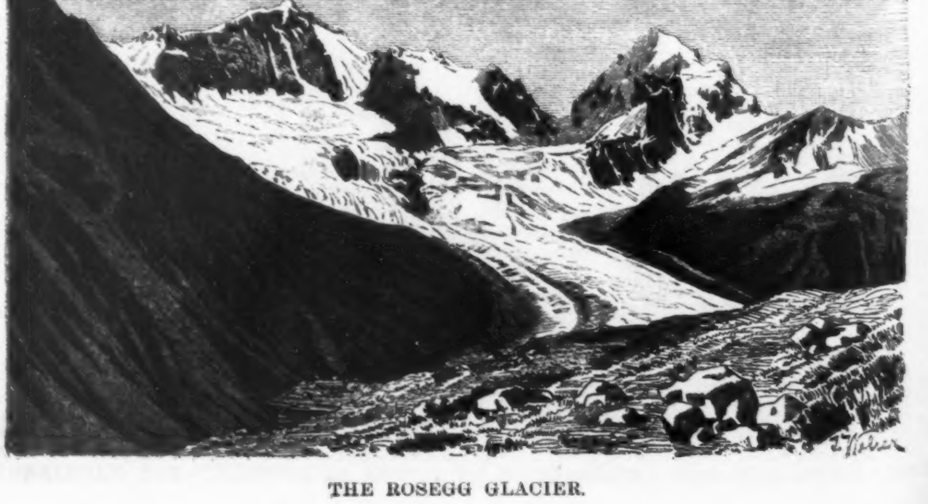
THE FALLS OF THE RHINE.

Let us suppose, for instance, that a tourist from England or the United States has been doing the lower Rhine and finds himself at Heidelberg, Baden, or Strassburg, with the intention of passing a few weeks in Switzerland. He will go from either of the points mentioned, either direct to Basle, or, what is more probable, he will take the Black Forest road via Offenburg to Schaffhausen, and the Falls of the Rhine, the Niagara of Europe. (Or, on the other hand, the tourist starting from Paris, or any point in France, will go to Basle or to Geneva, and enter upon his Swiss trip from either of these points; in the latter case, the tour will be made in the inverse direction from that in which it is herein described.)



THE QUAI AT ZURICH.

Here at his first entry upon Swiss territory a scene of inspiring beauty greets him. The bold plunge which Father Rhine here takes into the rocky chasm beneath the frowing battlements of Castle Laufen, thence rolling onward through a landscape of unsurpassed rural charms, fringed in on the distant horizon by a long



THE ROSEGG GLACIER.

silvery palisade of Alpine snow peaks, forms a picture of ever-changing yet never-ending charms. Moreover, within easy reach by day excursions are the historical city of Constance, the island of Mainau, where the ducal family of Baden pass their summers, and all the other attractive points which skirt the shores of the beautiful Lake of Constance; at Rheineck, where the upper Rhine enters the lake, diligence is taken for the favorite cure resort Walzenhausen; at Romanshorn, on a peninsula jutting out into the lake, one finds a pure air, fine scenery, and excellent accommodations; the through line from Munich, via Lindau, also enters Switzerland at this point. From Rorschach the narrow gauge mountain railway ascends to Heiden, the famous milk-cure resort, situated upward of 2,600 feet above the sea level, and commanding a splendid outlook upon the surrounding land and water. From Rorschach also one takes the train to St. Gallen, three-quarters of an hour distant.

THE UPPER ENGADINE.

VIEW FROM SILS-MARIA TOWARD SILVAPLANA.

St. Gallen is famous for its embroideries and for its having been the earlier center of educational and religious activity in Helvetia. It derives its name from an Irish monk, its founder.

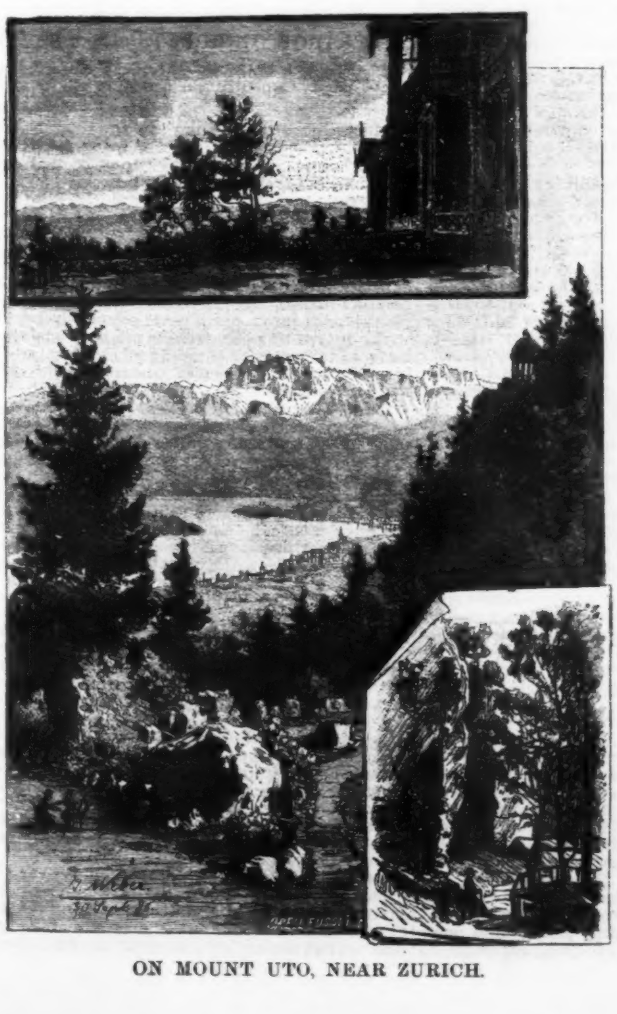
From St. Gallen one may make a delightful excursion to the Appenzeller land, a picturesque, populous, and prosperous mountain paradise, accessible by rail via Winkeln and Herisau. The village of Appenzell, the terminus, is reached in two hours. Three-quarters of an hour further on, by carriage, brings the visitor to the much-frequented cure resort Weissbad, pleasantly situated at the base of the mountains, and from which routes lead to various interesting excursion points.

Or a trip by rail to Teufen, Bühler, Gais and thence back to St. Gallen over the new tramroad of the Appenzeller country, can be comfortably made in an afternoon.

From Schaffhausen, or the Lake of Constance, the stream of tourist travel sets toward Zurich, the great commercial center of Switzerland, the ancient walled Turicum of the Romans, a city with a history, social, educational and political, filling many and stirring pages in the world's annals. Here is the Swiss Federal Polytechnic, here the now renowned University of Zurich, here an educational system which not only attracts students of all nationalities, but which here for centuries past made this city a recognized center for scholars and men of letters from all civilized countries. It is a notable fact that of late years tourists, interested at home in instructing the young, come in great numbers to Zurich to visit its educational institutions, its libraries, its wonderful Lake Dweller collection, and its educational museum. For the fair sex Zurich has also an especial interest on account of its famous silk industry and products, and as being the point where they can most advantageously do their shopping and replenish their wardrobes while *en route*. The summer trade is very large in this regard.

But not only to scholars and students does Zurich offer its attractions; it has charms for all who would see a handsome modern city built as a wing upon an ancient typical Swiss town; he must indeed be *blasé* and stolid who cannot find delight in its broad, long stretches of superb, shady quays, its well-kept gardens and parks, its stately, grand boulevard intersecting the entire city from end to end; its funicular road to the Polytechnic terrace; its quaint, old-fashioned nooks and byways; its good hotels, attractive shops and the general spirit of enterprise and activity characterizing its people. And in its environs are many attractive resorts: a sail up the lake to Rapperswyl, with its Polish museum, or a trip by rail to the summit of the Uetliberg overlooking the city, are not among the least of these. Within a short distance by rail there are many points of more than ordinary interest. Glarus, with its important manufacturing interests, its historical memories and its imposing scenery and surroundings, embracing the Glarnish mountain, the Heuboden Alp, and the Kloen valley; Lintthal, the Saasberg and the Kaerpfstock; and finally, the much-frequented alkaline sulphur baths of Stachelberg, on the left bank of the Linth, with an excellent hotel and medical attendance, are all within half a day's ride. Nor should the tourist omit a visit to Einsiedeln, the mountain shrine, two hours' distant from Zurich, whither annually many thousands of pilgrims from all over central Europe come to worship in the magnificent church erected on the site of the ancient chapel of St. Meinrad. Nor should he fail to run over to Baden, half an hour distant, and admire its elegant Casino, its numerous hotels and its thermal baths, and its Roman relics, for it was known in Nero's time as the *Aquæ Helvetiæ*. Or, if he will ride a bit farther on the same railway, he may visit the ancient castle of the Habsburgs, near Brugg, and, still further on, Saeckingen on the Rhine, the scene of Scheffel's famous "Trompeter" romance. Nor should he omit a trip to Winterthur, the pretty city of manufacturing and educational importance, one hour eastward of Zurich. In short, to the tourist who knows Zurich and its surroundings, there is offered an endless variety of pleasant summer excursions, none of them occupying more than a single day.

Zurich, moreover, is the central point of travel from which through cars may be taken to Vienna, Milan, Paris, or Stuttgart. From here too runs the main line of travel, via the picturesque Wallensee to Ragatz with its excellent hotels and attractive surroundings, including the wonderful gorge, through which the Tamina forces its way out to the Rhine valley. At Pfaeffers, at the head of this gorge, are the renowned thermal baths of that name. At Chur, an hour beyond Ragatz, one finds a picturesque and compactly built little city, and in its cathedral, among other remarkable paintings, Holbein's "Dance of Death." To Chur come most tourists contemplating a journey into the Engadine, with its numerous popular and well patronized resorts. A railway is now being constructed from Landquart to Davos, and there is no telling how much longer the diligence will continue to hold its time-honored sway in these mountain regions. But thus far, that sway is unbroken, and there are an endless number of nooks and valleys in these superb mountain regions to which we can only travel with the crack of the postillion's whip. And Chur is the central point of departure, and here are the routes, viz.: (1) to Dissentis and Andermatt by the Ober Alpine pass, and



ON MOUNT UTO, NEAR ZURICH.

WOOD CARVINGS IN THE CLOISTER OF WETTINGEN, NEAR BADEN.

thence by the Furka to Brigue and the Rhone glaciers; (2) to Thusis, Andeer, and over the Splugen to Chiavenna; (3) to Tiefenkasten, and thence to St. Moritz either over the Julier pass, or over the Albula, via Alvaneu, Ponte and Samaden; (4) the Landwasser route to Davos. It were useless to attempt in the space of this short article an adequate description of such charming resorts as those in which this region abounds. Fideris, Klosters, Arosa, Davos, Flims, Churwalden, Thusis, Muhlen, Zuoz, Tarasp, Maloja, and Pontresina all have their throngs of enthusiastic admirers who annually seek there their health and repose.

(*To be continued.*)

THE NEW STAR IN THE MILKY WAY.

A "NEW star" is a representative of a class of phenomena so rare that the number recorded during the last few centuries may be counted on the fingers. Hence we readily conceive that, since they are very striking in themselves as breaking the monotony of the starry heavens, and since also their nature was considered till quite recently to be shrouded in mystery, a most lively interest has been stirred up by the recent new arrival, not only among astonomers, but among that large class who are always on the *qui vive* for celestial wonders.

When tortured by the many instruments which modern science places at the observer's disposal, a new star is quite a thing *per se;* while at times their brilliancy is extraordinary, some of these "new stars" having rivaled both Mars and Jupiter in brightness, and even sometimes Venus.

The time that they take to wax and to wane varies very considerably; some have lasted at their greatest brightness only for days, others have remained visible for months or occasionally for years. It generally happens that a "new star" when first seen is brightest, and many have thought that this is simply because the star is at the stage most likely to be noticed by us; but this may not be the entire truth, as can be gathered from a consideration of the various views which have been put forward as to their nature.

Among the many hypotheses that have been suggested to explain how it is that these strange bodies make their appearance from time to time, we may first of all mention that which supposed them due to the sudden colliding of a comet with a star; another theory assumed that a star at some period of its existence became enveloped in a kind of crust or slag, which by some cause or other became disrupted, and revealed the glowing mass within.

Both these hypotheses, although they might to a certain degree explain the sudden brightness of the star, would not hold good with regard to the rapid diminution of its light, because, if large bodies are dealt with, the cooling must take a very long time.

The latest view put forward is, that these bodies are produced by the sudden meeting in space of two swarms or streams of meteoritic matter, each traveling with a considerable velocity, the sudden bright light being due to the collisions of the particles composing the swarms; and this hypothesis explains very well not only the sudden outburst, but the rapid decrease in brightness, due to the fact that only small particles are dealt with, and these must cool and dim quickly.

The appearance of the present new star, or "Nova," in the constellation of Auriga, was first announced by an anonymous post card received at the Royal Observatory, Edinburgh. Why the post card was sent anonymously remains a mystery; but the extraordinary reticence of the writer does not make any difference to the immortality of the discoverer; for while, on the one hand, newly-discovered comets, which are also of an apparently temporary nature, are always associated with the names of those who first observe them, new stars, on the other hand, are always referred to by the name of the constellation in which they appear.

The instrument now used to obtain observations of these strange visitors consists of a combination of an object glass, a prism which is placed outside the object glass, and a camera. The function of the prism is to separate the million strands of colored light which go to make white light; that of the object glass is to collect each color, concentrating it at the same time, so that finally we get a fine line of rainbow color.

This method of obtaining a spectrum is by no means modern, but was suggested and used by the German optician Fraunhofer about the year 1814. He placed a prism before the object glass of a theodolite, and in this way was the first to observe the spectra of some of the stars. By the use of this method, whether the eye or the photographic plate is used, the so-called "spectrum" of the body under observation can be studied without any difficulty. The length of the exposures required when photography is employed for stars of different magnitude varies very considerably; for the brightest a few minutes are generally ample, but for those of much smaller magnitude a space of two or three hours is by no means too long.

The spectra that are thus obtained are of various kinds, as various classes of so-called stars are observed. Some consist of bright lines on a dark background, others of dark lines on a bright background, while a mixture of both these is met with. These variations in spectra depend upon the fact that any substance that is heated sufficiently to emit light, whether in the heavens or on the earth, will give a spectrum. If it be a solid or liquid body, we shall have what is called a continuous spectrum—that is, a colored band bright from end to end, with no sign of any dark or bright lines about it. By continuing to heat this body until it becomes a mass of incandescent gas, the spectrum will become entirely changed, and will consist of a series of bright lines on a dark background, the number and position of the lines depending on the substance heated.

But suppose, now, that the light from an incandescent solid or liquid body passes through a gas, what kind of a spectrum should we have? Experiment shows that in this case we get a continuous spectrum crossed by *dark* lines, these dark lines being produced by the peculiar power that a gas possesses of absorbing those particular rays of light which it emits. Thus we see that if we are dealing with incandescent solid or liquid bodies, we obtain continuous spectra; if with incandescent gases, bright-line spectra; and if with absorption, dark-line spectra; the position of the lines in all cases revealing the chemical nature of the substances.

So much, then, for the general idea of the nature of a spectrum. There are some additional points to be considered when we are dealing with stars. If we observe the spectrum of a star at rest, we shall obtain lines, whether bright or dark, in their normal place in the spectrum. These lines will be peculiar to certain substances, and, in fact, their presence in the star is determined simply by them. If we deal with the light from a body which is not an apparent *point*, the lines will still keep the same positions for the same reason, but each one of them will be broadened equally.

Let us now suppose the star no longer stationary, but moving with a considerable velocity. In this case the wave length of each line will be no longer the same; but the line will have altered its position in the spectrum to an extent depending on the movement of the star toward or from the earth. The result produced in the spectrum will be the same with regard to the number of lines as was the case when the star was assumed to be motionless, but the lines will all have received a slight shift, either to one side or the other of their initial positions, according as the star is approaching or receding. If instead of one we now deal with two stars of the same chemical and physical structure, traveling with different velocities, either toward or away from us, the spectrum would show each line doubled, and the more rapid the relative motion the coarser will be the doubling. If the stars were so physically constituted that the same chemical substances were present in both, but giving bright lines in one and dark lines in the other, the spectrum would present a series of bright lines, each accompanied by a dark one, on one side or the other, according as the body which contained dark lines in its spectrum was approaching the earth or receding from it.

After this very brief statement of general principles, we can now refer to the observations that have already been made with regard to the spectrum of the present new star, observations unique in astronomical history, and of the highest importance and interest. It has been found to consist of both light and dark lines. The fact that pairs of bright and dark lines are seen proves that two bodies are in question. If we suppose two swarms of meteors colliding in space, the spectrum can be easily explained on this assumption in the light of the general principles referred to above. Further, the thickness of the lines tends to show that each one is produced by a large number of small incandescent masses moving at different velocities, rather than by one large one. The motion necessary to produce the doubling of these lines has been estimated, and the relative velocity of the two swarms has been put down as more than five hundred miles per second!

If the photographs should continue to show the same relative positions of the bright and dark lines, the observations would prove that this relative motion is not produced by the revolution of one body round another, but that a dense swarm of meteorites is moving toward the earth with a high velocity, and passing through another receding one of less density.

It will be seen that the observations harmonize well with the hypothesis that has been advanced on much less definite evidence; but this is not the only instance we can give of the grip that modern science has on large classes of phenomena which were supposed to be beyond the reach of man. The lines that have been photographed in the spectrum of this star are all such as could have been predicted with our knowledge of new stars.

As an instance of the advanced stage at which astrophysical science has arrived, we may say that, if we had no observations of new stars other than those already recorded of the present one, their whole theory could be obtained by induction. This may seem a "sweeping statement," but it is nevertheless true, for since many so-called "stars" are now known not to be "stars" like our sun, but simply clouds of meteoritic bodies clashing together, and since we know approximately the sequence of changes through which the spectra of these stars pass as their temperature is first increased and then reduced, each spectrum indicates the complexity of each swarm.

We have already seen that the doubling of the bright and dark lines indicates that we are dealing with two swarms in the present instance, one approaching and the other receding; we now learn that the condensation at which each of these swarms exists can be approximately determined; that which gives us the dark lines is denser than the one which gives us the bright ones.

In conclusion, it may be well to point out a difference of some importance between comets and these new stars. A comet, as is generally conceded, consists of a cloud of meteoritic dust *traveling round the sun*, sometimes in elliptic but more often in a parabolic or hyperbolic orbit; in other words, those traveling in elliptic orbits have been captured by the sun and return to it periodically, while those pursuing a parabolic or hyperbolic orbit after one passage near the sun are forever lost to us.

Thus a comet with an elliptic orbit may be said to be a member of the solar system, and on this account can approach very near to our earth; and in fact our earth has even passed *through* one, giving rise to the phenomena of a great number of shooting stars.

A new star, on the other hand, *never* approaches our system, but is formed at very great distances from us, distances probably as great as that of the nearest star, so that light, which travels one hundred and eighty-six thousand miles per *second*, takes about thirty years to complete its journey to us. Our new star, then, is already old.—*Saturday Review.*

THE "JUST PERCEPTIBLE DIFFERENCE."

A LECTURE was delivered on Friday, January 27, by Mr. F. Galton on the "Just Perceptible Difference," in which he pointed out that each sense organ has its own internal activities which are too faint to be perceptible in health, but which are not unfrequently perceived in illness, as, for example, ringing in the ear and peculiar taste or smell. Their unfelt effects might, however, concur with an ordinary sense impression and intensify it. He dwelt on the influence of the imagination and adduced instances where imagination produced effects that had been mistaken for faint sensations and sometimes for plainly perceptible ones. One of the most suitable subjects for such experiments he found to be the auditory imagination associated with words perused by the eye. He described experiments frequently made by himself at meetings of scientific societies, where he had obtained unrevised copies in print of the papers about to be read. Owing to some deafness he often found himself able to follow every word distinctly only so long as his eyes rested on the paper; he could detect the fact of any alteration in the wording, but was quite unable to make out the substituted words. On these occasions when he raised his eyes from the paper he could not follow the reader at all. He usually found it necessary to approach him by one quarter of the previous distance, in order to follow his voice by means of the ear alone. Hence the power of the imagination *plus* the power of the hearing bore the same relation to the power of the hearing alone as the loudness of the sound at four units of distance did to its loudness at three units. Their proportion was as the square of those numbers, or as 16 to 9. It followed that the power of the auditory imagination had seven-sixteenths of the power of a just audible sound—namely, of those overtones in the voice by which articulate words were distinguished. Similar results may be obtained by comparing the distances at which a play in a foreign language not well colloquially understood can be followed with and without a book of the words. Passing on to the second part of his lecture, Mr. Galton said the angular distance apart of two dots when they first began to merge into one was usually reckoned at one minute of a degree. When a row of 300 similar objects of any size is viewed at such a distance that the space they occupy in the visual field is not wider than that occupied by one inch on the page of a book, they produce the effect of a perfectly continuous and uniform line. If the dots are replaced by disks touching one another and arranged with moderate exactness along any flowing line, even fifty of them to the inch give a fairly good impression of continuity. It was further shown that the positions of fifty equidistant dots can be defined by as many letters, or else by twice as many figures, which, according to the telegraphic scale of five figures to a word, was equivalent in cost to twenty telegraphic words. Counting the top of the paper as north, the bearing of each dot from its predecessor was recorded to the nearest of the sixteen principal points of the compass by means of one or other of the first sixteen letters of the alphabet. The effect of error in laying down any one dot had but a trifling effect on its successors. A severe test of the applicability of this method was made by comparing the profile of a girl copied from a Greek gem with its reproduction from a formula containing 400 letters, which was the equivalent of 160 telegraphic words. The two portraits—the original and the reproduction—were reduced photographically to various sizes. When the scale was such that fifty dots were included in the length of one inch of lineation, the effect was unexpectedly good. When the portrait was reduced to the size of that on a postage stamp, it had all the appearance of a delicate line engraving. This and other tests showed that it was feasible to reproduce characteristic lines of any description from a written formula. It was pointed out that the power of doing so might become of practical utility, considering the large and increasing space given in newspapers to telegraphic intelligence, the gradual introduction of illustrations into the daily papers, and the not infrequent occurrence of local events of high importance which did not admit of a clear description without an accompanying sketch or plan, however rude. The cost of sending by telegram from the United States the formula for any plan or design containing the same total amount of lineations as in the profile mentioned would be £8.—*Lancet.*

STRANGE INCIDENTS IN PRACTICE.

By SIR WILLIAM B. DALBY, F.R.C.S. Eng., M.B. Cantab., Consulting Aural Surgeon to St. George's Hospital.

I USE the word "strange" in the sense that many of the incidents presently referred to cannot be accounted for, so far as I know, by any course of cause and effect with which the profession can be said to be at all accurately familiar. No doubt in the memories of many physicians incidents have happened in regard to which they have often pondered and wondered without being able to arrive at any definite or decided explanation; and could it be obtained, an account of some of their experiences would be profoundly interesting, not only from a medical, but also from a literary, point of view. Be this as it may, perhaps the very last place from which interesting occurrences might be expected would be from th practice of an aural surgeon, and yet this is not so entirely barren of unexplainable incidents as might be supposed.

It is common enough to hear it said of So-and-so, "It was a terrible shock to him; he has never been the same man since," and this can be readily understood; but it is often not easy to duly appreciate how shock caused by emotion, and not by violence, acts, except on the mind. The effects of shock are assuredly not always confined to the mind, since it has been known to cause instant death, not to mention various degrees of collapse. All this part of the subject, so far as it relates to bodily effects, is graphically and charmingly dealt with in Sir W. Savory's article on collapse in Holmes' "System of Surgery," but I wish to draw attention to the effects of emotion on the special senses. Some years ago a lady was standing before her toilet table, and looking through an open door into her husband's dressing room, saw in a mirror the reflection of her husband in the act of cutting his throat. From that moment she was absolutely deaf to all sound. A similarly sudden and complete loss of hearing some years later happened to a young married lady who was suddenly brought face to face with her dead husband whom she believed to be quite well, and whom she was going to meet after a long absence. I have on various occasions alluded to the remarkable effects which are produced upon the hearing by emotional influences, not only by great mental shocks but by mental strain, strain which is sometimes of a prolonged character, while at other times the period of strain only extends over a few minutes, such as is produced by bad news unexpectedly given, or news which entails calamity on the individual or some one dear to him. Not only sudden grief, but also overwhelming joy I have known to instantly make

its recipient quite deaf; in short, any very powerful emotional influence is capable of producing this effect. This cessation of the functions of nervous matter which includes the special sense of hearing is, to say the least, very remarkable. It is but a poor and lame explanation to ascribe it to what is termed "shock." At what points does the shock act? Certainly not as in the constitutional effects of shock upon the heart and mind. What portion of the brain is affected, and in what manner? Here, then, are grounds for speculation. The fact of the hearing being lost on both sides places the *locale* of the lesion very deep, and one is led to think of the medulla. It is in the highest degree probable that post-mortem appearances would not reveal anything, for this has been shown to be the case in examples of furious tinnitus with loss of hearing on one side. It would seem that the sense of hearing hangs (to speak metaphorically) by a thread very slender when compared to the sense of sight, and in this way bears a strong resemblance to the sense of smell, which on several occasions I have known to be lost by very strong emotional influence; and not only to be lost, but to become disordered, and so acting on the sense of taste as to produce curiously unpleasant results. Thus, a gentleman who was quite remarkable for his highly sensitive and accurate taste in the matter of wine, and upon whose opinion vintages were bought, lost his sense of smell and with this, of course, his sense of taste, but with this addition, viz., that the sense, besides being lost, became disordered in an unnatural manner, so that what he ate and drank left behind it a horrible musty odor, which he described as resembling the faint odor of a corpse. The health, both bodily and mentally, of this man was excellent, and the change to which I have referred was sudden and ascribed by him to an emotional influence—in short, to "shock." Allowing all pathology to be disordered physiology, the examples I am dealing with are disordered physiology without an outline such as defines ordinary pathological change. If any solution of these incidents is forthcoming, it will come, I imagine, from the physiologist, who will point to the insecure tenure which appertains to the sense of hearing—also to the sense of smell and her twin sister the sense of taste. Toward the solution of these problems we can only as pathologists proceed upon a process of gradual exclusion. Thus, in regard to hearing, we should exclude, of course, the conducting apparatus of the ear, seeing that this remains throughout healthy, as may be demonstrated by examination. Seeing, also, that the loss of hearing is symmetrical, we should have to exclude the expansion of the auditory nerve in the labyrinth—also all that portion of the brain which includes the auditory tracts until their reunion, or, more strictly speaking, until their origin. At last we almost imperceptibly approach a point where we seem to helplessly fall back on a confession of ignorance which acknowledges the triumph of mind over matter. Our safe return from this feeble position would appear to depend on falling once more into the pathway of clinical experience and recalling to our aid examples in which the hearing has been suspended symmetrically and nervously—that is, where the perception of sound has been lost while the conduction of sound remained good—from disturbing causes which obviously were local. Thus I have known the hearing to be partially suspended—and in a high degree—by a loaded state of the intestines and to return perfectly after the relief afforded by medicine; a suspension of hearing during a sleepless condition brought about by overwork to have disappeared after a prolonged sleep induced by medicine; the deafness accompanying an irritable state of the brain, obviously of gouty origin, to disappear after a full dose of medicine. All these examples at once point to a temporary condition of congestion of the vessels of the brain; therefore we may somewhat reasonably conjecture that what a slowly arising congestion of the cerebral vessels is capable of producing at one time in the cases of recovery, a sudden and temporary congestion of the same vessels will at another time bring about in the examples from which there is no recovery. The precise way in which the congestion acts remains as obscure as before, but the methods of investigation, so far as the poor surgeon is concerned until helped in his efforts by the physiologist, remain in the direction of careful clinical observation. Another of the reasons why we are led to fall back upon congestion of the vessels of the brain as an explanation (however imperfect it may some day prove to be) is analogy. I refer to cases where the hearing is lost irrecoverably in diseases such as typhus fever or mumps. In both diseases, of course, I exclude all cases where the middle ear suffers, and in mumps I only include those cases where the hearing is suddenly lost at a precise time, which is not even attended with any pain in the ears. There certainly has never been any satisfactory explanation as to why a child suffering from mumps (where there has been no ear-ache nor even slight catarrh of the ear) should suddenly and absolutely lose all hearing in one or both ears, and I have seen many examples of this. No better explanation, I repeat, at present exists than to refer the cause to the congestion of the cerebral vessels. The difference in demeanor between typhus fever or its allies and mumps is that in the case of typhus fever the subject generally recovers the sense of hearing after the fever, but in mumps never. But if congestion of a passing nature is difficult to understand, so far as its effects on hearing are concerned, what an increased difficulty surrounds irritation acting from a distance on a special sense! How exceedingly subtile must be the process of change which can cause a complete return of good hearing (in the case of a child who was deaf and dumb) after the discharge from the bowels of 87 lumbrici and innumerable oxyurides—and this is a well-known and well-authenticated case! I am fully aware how very inadequate the explanation (implied by congestion of the cerebral vessels) I have suggested may appear, and in no sense do I offer it as a satisfactory one, but merely as one toward which clinical observation points as a probable solution until further knowledge is able to explain the suspension or loss of a special sense which at present pathology is unable to account for. In short, I have done little more than enunciate an interesting problem for consideration.

Of an altogether different kind is the next strange incident which I have to relate. A lady aged about twenty-five had been subjected to a good deal of fatigue and want of rest. After this she was attacked by acute inflammation of the external ear, first in one and then in the other ear. This was accompanied by much swelling and pain, with a purulent discharge in the external canal, but the middle ear had not been involved. On the second or third visit to me (I cannot remember which), on introducing a small sized speculum into the right ear, the edge of the speculum grated against something. I found this to be a piece of a needle, the pointed end, representing about one-third of the whole needle, embedded in the tissues. This I extracted with a small pair of forceps. On two future occasions I extracted the other pieces, the three pieces thus removed representing the entire needle. This lady professed to be quite unable to understand the presence of the needle. She was a most sensible person, by no means of the hysterical type, and appeared to me to be as much astonished as I was at the circumstance, which by no means accounted for the inflammation of the right ear, any more than of the left, in which there was nothing unusual. The inflammatory condition of the ears was recovered from completely, but up to this hour I have not been able to account for the three pieces of needle. Had there been a suspicion of hysteria, a possible solution might have been found; failing this, there was no indication to proceed upon and the case remains at present among the unexplainable.

Once, and once only, have I seen a case of pure hysterical deafness, and from its very completeness it is worth recording—that of a young lady who was brought to me by her mother and medical attendant, the latter an exceedingly able man and thoroughly appreciating the situation. One morning on awakening she professed to be unable to hear any sound whatever, and conducted herself so appropriately to this condition that it was found impossible to surprise her into any indication of hearing. A year previously she had professed to be absolutely blind and was examined by a well-known ophthalmic surgeon, who declared that both eyes were perfectly healthy. Notwithstanding this, she proceeded to move about and behave in every minute detail as if totally blind, and continued in this course for many weeks, until one day she said her sight had suddenly returned. When I saw her I was certain that she could hear, and proposed (not in her hearing of course) that she should be led across a room and that a gun should be unexpectedly fired at some distance behind her. I imagined that she could not fail to manifest some signs of hearing the explosion, and that possibly after that she would declare the hearing to have returned. This experiment, or rather treatment (for so I regarded it), was not permitted, and she remained for over six months without alteration, when one day the hearing was, she affirmed, as suddenly restored as the previous blindness. It is certainly not conceivable that in any other class of life than that to which she belonged this attempt to excite sympathy (for this appears to me the nearest to a true explanation that I can fancy) could have been so prolonged as it was—for there are numerous ways in which the deception could have been exposed—if those about this girl had appreciated the position and had showed some determination in the matter.

A more curious circumstance than this in relation, not to hearing, but to speech, once came under my notice. A physician was occasionally for several years consulted by a gentleman with regard to his health, which was, however, generally good. The patient was a middle-aged man of robust appearance. His hearing was perfect, he could understand everything that was said to him; but he never spoke. The consultations were conducted on his part in writing and he habitually carried about pencil and paper—in fact, writing was his only means of communication. He was an intelligent and fairly educated man. My friend the physician knew that I was very much interested in the acquirement of speech, in the loss of speech following loss of hearing in children, and in its recovery after the return of hearing, so he asked his patient to call upon me. The interview was conducted as usual, the patient writing and I speaking in the ordinary voice. I found the ears healthy and the hearing normal, I could not get a satisfactory explanation of how he lost the power of speech, except that it occurred in boyhood. About a year after my interview with him he went again to see the physician, and, to the latter's astonishment, spoke like an ordinary person, saying that the power of speech had suddenly returned, adding that he was utterly unable to ascribe this return to any cause, any more than he was able to explain the sudden loss of speech—a simple inability to enunciate words to begin with, and next, a sudden return of this power.

This was an entirely new experience to me in the loss and recovery of speech. I had frequently watched the gradual loss of speech when the hearing had been lost in young children from scarlet fever and other causes, until the child had in a few months become quite dumb. I had also frequently watched the acquirement of speech in a child who had lost it from partial deafness in infancy and regained it after the hearing had been recovered under treatment, and I had, of course, often enough observed the acquirement of speech in a deaf and dumb child under instruction in lip reading and in articulation. But this was to me, and still remains, something so entirely exceptional that I am quite at a loss to offer any explanation.—*The Lancet.*

M. PASTEUR'S SEVENTIETH BIRTHDAY.*

FRENCHMEN may be cordially congratulated on the enthusiasm with which the seventieth birthday of M. Pasteur was celebrated on Dec. 27. It afforded a most striking illustration of the way in which they appreciate the services rendered by men of science. But the celebration was not, of course, one in which only the countrymen of M. Pasteur were interested; representatives of science from many different parts of the world were present to do honor to the illustrious investigator.

The ceremony took place in the great amphitheater of the Sorbonne, which was crowded by a brilliant assembly, including many of the foremost men of the day, not merely in science but in politics and in literature. M. Carnot was present, and among those who supported him was M. Dupuy, the Minister of Public Instruction. M. Pasteur entered the amphitheater leaning upon the arm of his son and upon that of the President of the republic. All who were present rose to their feet and greeted the hero of the day with loud cheers. M. Pasteur, who was much affected by this reception, took his place beside his colleagues of the Institute and a row of ambassadors and ministers.

The proceedings were opened by M. Bertrand, perpetual secretary of the Academy of Science, who acted as chairman. At his request an address was delivered by the Minister of Public Instruction, who spoke eloquently of the great qualities displayed by M. Pasteur during his splendid career, and of the benefits conferred on mankind by his labors. After the minister came M. d'Abbadie, the president of the Academy, who, expressing the congratulations of the Institute, presented to M. Pasteur the large gold medal which had been struck in commemoration of the day. The medal bears on the obverse a likeness of M. Pasteur, while on the reverse is the following inscription: "To Pasteur, on his seventieth birthday, from grateful science and humanity, Dec. 27, 1892." M. Bertrand also spoke, and both his speech and that of M. d'Abbadie were cordially applauded. Sir Joseph Lister, one of the delegates sent by the Royal Society, was warmly greeted. He read in French the following address:

"M. Pasteur, the great honor has been accorded me of offering you the homage of medicine and surgery. There is certainly not in the entire world a single person to whom medical science is more indebted than to you. Your researches on fermentation have thrown a flood of light which has illuminated the gloomy shadows of surgery, and changed the treatment of wounds from a matter of doubtful and too often disastrous empiricism into a scientific art, certain and beneficent. Owing to you, surgery has undergone a complete revolution. It has been stripped of its terrors, and its efficiency has been almost unlimitedly enlarged. But medicine owes as much to your profound and philosophic studies as does surgery. You have raised the veil which had for centuries covered infectious diseases. You have discovered and proved their microbic nature, and, thanks to your initiative, and in many cases to your own special labor, there are already a host of these destructive disorders of which we now completely know the causes. 'Felix qui potuit rerum cognoscere causas.' This knowledge has already perfected in a surprising way the diagnosis of certain plagues of the human race, and has marked out the course which must be followed in their prophylactic and curative treatment. In this way your fine discoveries of the attenuation and reinforcement of virus and of preventive inoculations serve, and will serve, as a lode star. As a brilliant illustration, I may note your studies of rabies. Their originality was so striking that, with the exception of certain ignorant people, everybody now recognizes the greatness of that which you have accomplished against this terrible malady. You have furnished a diagnosis which immediately dispels the anguish of uncertainty which formerly haunted him who had been bitten by a dog mistakenly supposed to be suffering from rabies. If this were your only claim on humanity, you would deserve its eternal gratitude. But, by your marvelous system of inoculation against rabies, you have discovered how to follow the poison after its entry into the system, and to conquer it there. M. Pasteur, infectious maladies constitute, as you know, the great majority of the maladies which afflict the human race. You can therefore understand that medicine and surgery are eager on this great occasion to offer you the profound homage of their admiration and of their gratitude."

Among other addresses was a striking speech by the mayor of Dole, M. Pasteur's birthplace. After the presentation of gifts by foreign delegates, M. Pasteur rose and spoke a few words, which, according to the Paris correspondent of the *Times*, were "broken by sobs." A speech was then read for him by his son. In this speech, as reported in the *Times*, M. Pasteur said, after referring to M. Carnot's presence: "In the midst of this brilliant scene, my first thought turns with melancholy to the recollection of so many scientific men who have known nothing but trials. In the past they had to struggle against the prejudices which stifled their ideas. These prejudices overcome, they encountered obstacles and difficulties of all kinds. Even a few years ago, before the public authorities and the municipal council had provided science with splendid buildings, a man whom I loved and admired, Claude Bernard, had for a laboratory, a few steps from here, nothing but a low damp cellar. Perhaps it was there he was struck by the malady which carried him off. When I heard of the reception intended for me, his memory rose first of all to my mind. I hail that great memory. It seems that you have desired by an ingenious and delicate idea to make my entire life pass before my eyes. One of my Jura countrymen, the mayor of Dole, has brought me a photograph of the humble house where my father and mother lived under such difficulties. The presence of all the pupils of the Polytechnic School reminds me of the glowing enthusiasm with which I first entered on the pursuit of science. The representatives of the faculty of Lille recall for me my first studies on crystallography and fermentations, which opened quite a new world to me. What hopes filled me when I discovered that there were laws behind so many obscure phenomena! You have witnessed, my dear colleagues, by what a series of deductions I have been enabled as a disciple of the experimental method to arrive at physiological results. If I have sometimes disturbed our academies by somewhat livelier discussions, it is because I was passionately defending truth.

"You, lastly, delegates of foreign nations, who have come so far to give France a proof of sympathy, you afford me the most profound gratification which can be experienced by a man who invincibly believes that science and peace will triumph over ignorance and war; that peoples come to an agreement not to destroy, but to build up, and that the future will belong to those who have done most for suffering humanity. I appeal to you, my dear Lister, and to you all, illustrious representatives of science, medicine and surgery. Young men, trust those certain and powerful methods, only the first secrets of which we yet know. And all of you, whatever your career, do not allow yourselves to be infected by vilifying and barren skepticism; do not allow yourselves to be discouraged by the gloom of certain hours which pass over a nation. Live in the serene peace of laboratories and libraries. Consider first of all, 'What have I done for my education?' and then, as you advance, 'What have I done for my coun-

* For portraits of M. Pasteur, see SUPPLEMENTS 386 and 762.

try? until the moment when you will perhaps have the immense happiness of thinking that you have contributed in some way to the progress and welfare of mankind. But whether your efforts are more or less favored in life you must, on nearing the grand goal, be entitled to say, 'I have done what I could.' I express to you my profound emotion and warm gratitude. Just as, on the back of this medal, the great artist Roty has concealed under roses the date of birth which weighs so heavily on my life, so you have desired, my dear colleagues, to give my old age the spectacle which could most delight it—that of these eager and loving young men."

This closed the ceremony. M. Carnot, before quitting the building, walked over to M. Pasteur and embraced him. The celebration was one of which France has good reason to be proud, and Englishmen may well regret that such a demonstration, common to governors and governed, would in this country be impossible.—*Nature.*

EGBERT JUDSON.

EGBERT JUDSON, who died in January last in California, was distinguished among the millionaires of San Francisco as an original investor in manufacturing enterprises instead of a cent-per-cent man. And not only did he invest his money in industrial enterprises, but he originated and established them, afterward taking an active personal interest in the conduct of their affairs. It has been unfortunate for the city and State that there were not more rich men like him in this respect.

He seemed to possess a remarkable faculty for organizing and building up manufacturing establishments, and his means have been such that wherever he has given his attention, it has brought the confidence of others who have been willing to put in their capital. He not only possessed great executive ability, but was always willing and able to take off his coat, go to work and show how a thing should be done. There was nothing of the "kid-glove expert" about Mr. Judson, who was a plain man, but one with a great deal of practical experience and plain good sense. All who have been associated with him speak highly of his integrity, industry and ability.

Mr. Judson came to California in 1850 and went to the mines. After a year he went East and returned in 1852. It is said he started the first assaying office San Francisco ever had. In 1855 he became interested in the San Francisco Chemical Works and the manufacture of acid. Years ago he invested in hydraulic mines in Nevada and Butte Counties, and was the first man to successfully carry water through a wrought iron pipe passing down one side of a ravine and up the other under a 900 foot pressure. He made his own engineering calculations for this inverted siphon, and the credit of its success was wholly due to him. He was still interested in hydraulic mining up to his death, being one of the principal owners in the North Bloomfield mines, the largest hydraulic mines in the State. He was the principal owner in the Kennedy mine, Amador County, now the leading gold producer among the quartz properties of California. As showing Mr. Judson's willingness to advance a variety of interests, the following are given as a few of the enterprises in which he was a large owner: Judson Manufacturing Company; Judson Dynamite and Powder Company; California Paper Company; Western Fuse and Explosives Company; San Francisco Candle Works; San Francisco Chemical Works; California Pulp Works; Sather Bank; Pioneer Pulp Company; chemical works at Newark, N. J.

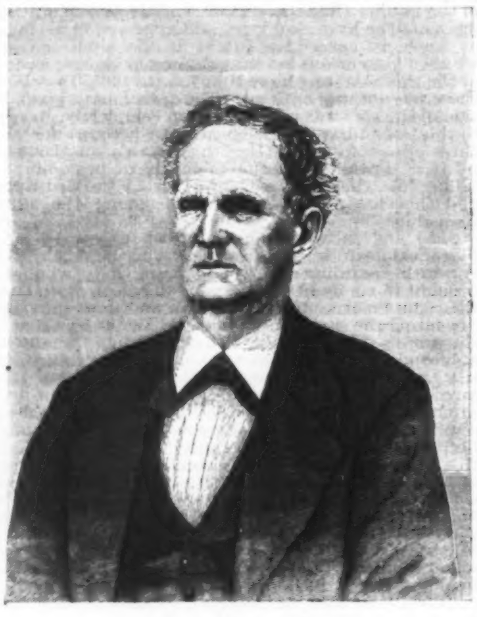
In the powder business of this city Mr. Judson was a most prominent factor. He was one of the originators of the Giant Powder Co., the first to manufacture high explosives on this coast. Not long after he invented and patented the Judson powder for bank blasting, a substance which soon displaced others in gravel mining work. The original high explosives were composed of nitro-glycerin and absorbents; but this powder consisted of particles of black powder rendered non-absorbent by a peculiar process, mixed with nitro-glycerin so that the nitro-glycerin remained on the surface. Only a small proportion of nitro-glycerin was used, but the powder was found to be peculiarly effective. The sales of the new product were immense, and the substance was patented all over the world.

Only a few years since, Mr. Judson organized the Judson Dynamite and Powder Co., and built very extensive works on the bay shore in Alameda County, the largest powder works at the time on the coast. In forming this company he associated with him some of the most prominent men and largest mine owners in this State, all directly interested in the development of the mineral industry of the coast. Their idea of joining together to manufacture blasting powder was the result of their determination to avoid the payment of the high rates previously charged for explosives. This company soon brought the price of powder down from 18 cents to 12 cents a pound. Mr. Judson had previously left the Giant Powder Co. and disposed of all his stock in it.

Simplicity of habits and mind were marked characteristics of Mr. Judson. Notwithstanding his great wealth, he never asserted himself or sought for any prominence. If he had a weak point in business, it was that he was a little too frank himself, because he thought other people were equally honest. It was a hobby with him that the enterprises with which his name was identified should become successful and advance the manufacturing industries of California. He thought more of this than of the money they would make for him. His last enterprise, the Judson Dynamite and Powder Co., was his greatest and one which has been successful and profitable from its inception. It was somewhat surprising that at his advanced age he should start such a large new industry, and his business rivals were not pleased at his efforts in this direction, particularly as they resulted in such a sweeping reduction of the products manufactured.

The exact amount of Mr. Judson's estate is not known, but it is doubtless between $2,000,000 and $3,000,000. He was an unmarried man and leaves the estate to his four nephews and nieces, who are to receive the income for ten years, at the end of which time the property is to be divided. It is the desire of testator that the executors and trustees shall continue business jointly with J. L. N. Shepard for ten years. A codicil dated October 5, 1888, provides that the above request is not to be construed as exclusive of any other partnership or joint venture in which testator may be interested at the time of his death, and the directors are authorized to continue any and all business in which testator may be a partner at the time of his death, with the same powers as himself if living.

This codicil well illustrates the absolute singleness of purpose of Mr. Judson. He simply did this so that the men associated with him in business would be put to no inconvenience because he was taken away.



EGBERT JUDSON.

Active work was an essential feature of Mr. Judson's career, and he kept "in harness" until the end of his life, yet he was a man almost 81 years of age. At the time of the explosion of the Giant Powder Works at Fleming's Point he was a short distance away and jumped in his buggy to drive over to the scene. The horse ran away with him, going toward the fire. Just then the second explosion occurred, and Mr. Judson was thrown violently to the ground, being not many hundred feet from the magazine. He was permanently deafened in one ear and received some internal shock which undoubtedly hastened his death.—*Min. and Sci. Press.*

GEORGE NEWBOLD LAWRENCE.

BULLETIN No. 40 of the United States National Museum is a book of 125 pages, by L. S. Foster, devoted to the bibliography of the published writings of George Newbold Lawrence, the celebrated ornithologist and man of science. Mr. Foster gives the following biographical sketch, for which and our portrait engraving we are indebted to the Bulletin:

"Spencer F. Baird, who has aptly been considered the Nestor of American ornithologists, possessed, besides the capacity for organization, the power of guiding as well as enkindling enthusiasm.

GEORGE NEWBOLD LAWRENCE.

"Fortunate was it for ornithological science when, in 1841, Prof. Baird and Mr. George N. Lawrence formed an acquaintanceship, which soon ripened into a close and lasting intimacy. Stimulated by this, Mr. Lawrence then commenced the scientific study of birds. From his earliest recollection, however, birds had attracted him and he had paid considerable attention to them.

"George Newbold Lawrence was born in the city of New York, where he has always resided, on October 20, 1806. His parents were both of English stock; his father's ancestors, coming to this country in 1635, finally settled in New York, and those on his mother's side located in Burlington County, N. J., in 1681.

"His business career was an active and successful one, he having at the early age of twenty entered into a partnership with his father and others, in the wholesale drug business in New York City. In this he continued for thirty-six years, devoting assiduously his spare time to ornithology. In his earlier efforts to preserve bird skins he endeavored to do so without removing the body of the bird, lacking as yet the counsel of a skilled taxidermist. This indicates that he felt an irresistible spur to action, the impelling force of all earnest souls.

"Repeatedly he was of service to the Smithsonian Institution in the details of outfitting expeditions for field work, and in many ways aided Prof. Baird in scientific matters. He took the initiative in organizing the Ober expedition to the Lesser Antilles.

"He became a near neighbor of John James Audubon at about the close of the life of that illustrious naturalist, and was very familiar with his sons Victor and John. For the many years covered by his activity in ornithology he has conducted an extensive correspondence, embracing most of the naturalists throughout the world, particularly those interested in ornithology.

"His collection of bird skins, of great scientific value, numbering about 8,000 specimens, and containing some 300 types of new species of birds, was deposited in the American Museum of Natural History, New York City, in May, 1887.

"He joined the Lyceum of Natural History, in the city of New York, in 1845, and now is a member, a fellow, and a patron of its successor, the New York Academy of Sciences. Upon the organization of the American Ornithologists' Union, in 1883, he became an active member, and at its eighth congress, November, 1890, he was elected an honorary member. Of the Linnæan Society, of New York, he likewise is an honorary member, having been chosen as such April 13, 1878. The British Ornithologists' Union made him a foreign member in 1872, and he is also connected with a large number of kindred societies in this and other countries.

"Throughout his scientific career Mr. Lawrence has commanded the confidence and respect of all of his contemporaries, with many of whom he has formed cordial friendships, and it is with amazement that we consider the long list of great names, from Vieillot to the present time, that since the birth of Mr. Lawrence have impressed indelibly the brilliancy of their splendid genius on American ornithology. Wilson, Audubon, Bonaparte, Brewer, Nuttall, Baird, Cassin, Giraud, De Kay, and many more have come, and passed on, during the stretch of one life. Of a verity, American ornithological science has been favored in its leaders during the last fourscore years.

"The beneficial influence of the labors of Mr. Lawrence, with pen and pencil, on the progress of American ornithology has been great and undisputed, but it was particularly among the avifauna of the West Indies, Mexico, Central and South America that his most strenuous efforts were exerted. All but 17 of the 319 new species of birds described by him came from that region. Endowed with great power of analysis and a remarkable patience, he applied these to the investigation of specific distinctions, and his conclusions have but rarely been questioned.

"A scrutiny of the titles of his numerous papers will fully indicate the wide scope and excellent character of the work of this veteran ornithologist."

[NATURE.]

SIR ARCHIBALD GEIKIE.

SOME months ago the British Association for the Advancement of Science was holding its annual meeting at Edinburgh under the presidency of Sir Archibald Geikie, F.R.S., Director-General of the Geological Survey of the United Kingdom.

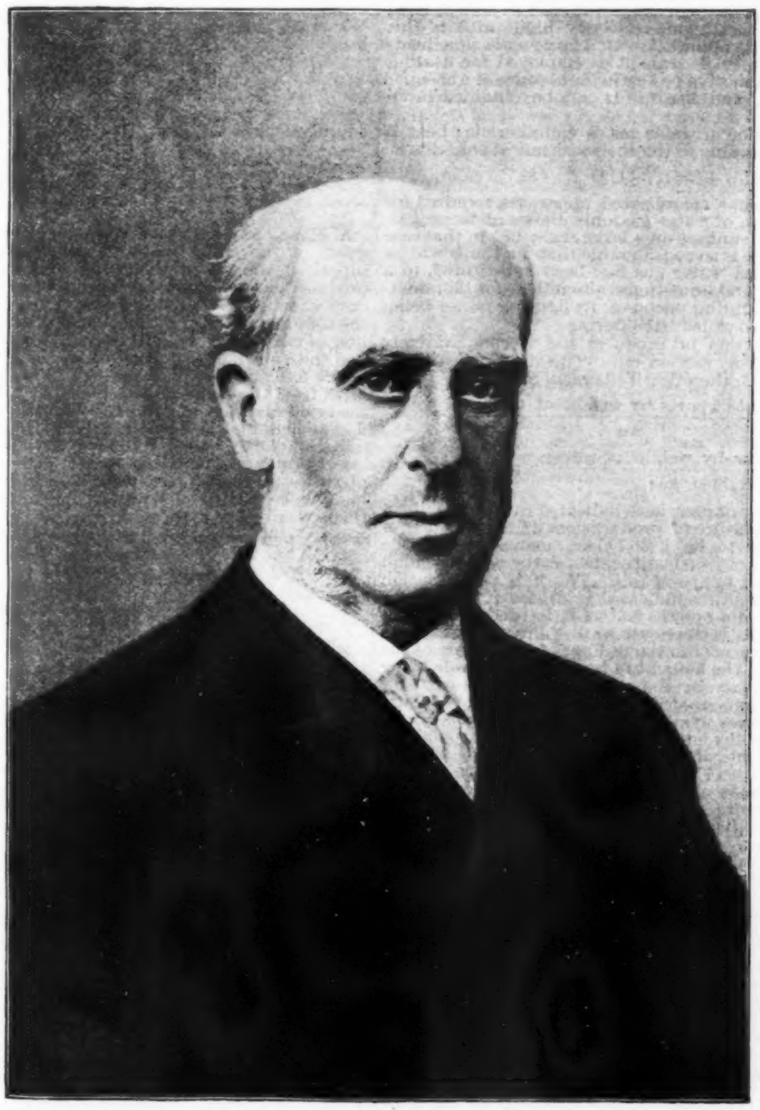
It may well be said that a more appropriate choice could hardly have been made by the council of the learned association. Not only is Sir Archibald a thorough Scot, born and educated in Scotland, where he fulfilled for many years the most important duties as a member of the geological staff, and later as a professor in the University of Edinburgh, but, having long been engaged in the supervision of the Scottish survey, he mapped with his own hand many hundreds of square miles of country, and through the entire scenery of Scotland there is not a single point with the peculiarities of which he did not make himself thoroughly familiar. His knowledge of the ground is not at all restricted to geological relations. In Sir Archibald the qualities of the geologist are combined with those of the enthusiastic lover of landscape, and his able pencil excels in drawing original sketches in which the outlines, peculiar shades, and, one might say, the general spirit of the scenery are fixed with the most striking accuracy. Obviously, therefore, he was the right man to be placed at the head of the Edinburgh meeting, which many prominent foreign investigators attended in the hope of afterward traveling, both as tourists and as men of science, through the most interesting fields of the Highlands. Nobody could have been better fitted to introduce them to the country. When putting Sir Archibald in the chair at Edinburgh, the British Association not only did due justice to one of the most distinguished sons of "modern Athens," it also took the best course to secure from foreign guests the fullest recognition of the various merits of Scotland.

Sir Archibald Geikie was born at Edinburgh in 1835. We learn from a notice in the *Mining Journal* that he was educated at the Royal High School and at the Edinburgh University. When he was only twenty years old he became an assistant on the geological survey for Scotland, and proved so able that in 1867, when the Scottish branch of the survey was made a separate establishment, Sir Roderick Murchison deemed he could not do better than confer the directorial powers on the young assistant whom he had appreciated at work. Four years later, the chair of geology and mineralogy at the university having been founded by Sir Roderick with a concurrent endowment by the crown, Archibald Geikie was invested with the new professorship, which he resigned only at the beginning of 1881, when he was appointed to succeed Sir Andrew C. Ramsay as director-general of the

geological survey of the United Kingdom, and director of the Museum of Practical Geology in Jermyn Street.

That the new director had not disappointed the hopes he had excited, appeared with sufficient clearness when, some time ago, the Queen conferred on him the honor of knighthood. Now it is our duty to note the chief features of his activity, and to state what personal part Sir Archibald Geikie has played in the recent progress of science It is scarcely necessary to say that his geological achievements are too important to be conveniently reviewed in a few lines. Nevertheless we shall try to give a general idea of the prominent results to which his name must be attached.

Early appointed, as he was, an officer of Scotland's survey, he had from the beginning to deal with the most puzzling problems involved in the stratigraphy of the Highlands. The case was a very difficult one, and gave rise to much controversy between Sir Roderick Murchison and many other geologists, among whom it will be sufficient to quote the respected name of Nicol. As in the Highlands gneisses and ordinary crystalline schists were seen resting, with apparent conformity, on Silurian strata, it had been admitted by Murchison that the sequence was a normal one. Therefore the crystalline schists had to be regarded, in spite of their Archæan appearance, as metamorphosed Silurian deposits. Such an assumption had a considerable bearing on other geological problems, as it rendered highly probable the theory that the so-called primitive gneisses were altered sediments, and had nothing to do with the early crust of the molten globe.



SIR ARCHIBALD GEIKIE.

That Sir Archibald should at first have taken his director's side is not at all surprising. But he was never quite satisfied, and his love of truth led him, as soon as he was in a position to do so, to undertake a detailed review of the facts. Since the discovery of Silurian fossils in the rocks of N. W. Sutherland, it had been recognized that the key to the structure of the Scottish Highlands was to be searched for in that region. Accordingly, in the years 1883 and 1884, MM. Peach and Horne were intrusted with a careful study of the Durness and Eriboll districts. They were very far from being directed to obtain means of justifying the old survey. "It was a special injunction to the officers" (we quote Geikie's own words) "to divest themselves of any prepossession in favor of published views, and to map the actual facts in entire disregard of theory."

From the work ably carried on by the distinguished surveyors, and verified on the spot by the director-general, it appeared clearly that Murchison had been deceived by prodigious terrestrial disturbances, of which, at the time, nobody could have formed an idea. Over immense reversed faults, termed *thrust planes* by Geikie and his officers, the older rocks on the upthrow side had been, as it were, pushed horizontally forward, covering much younger sediments; and the displacement attained the almost incredible distance of more than ten miles. Sometimes an outlier of the displaced ground was capping a hill, while the remainder had been swept away by erosion, and the strangeness of the case led the observer to write, "One almost refuses to believe that the little outlier at the summit does not lie normally on the rocks below it, but on a nearly horizontal fault."

Disturbances of that kind had already been noticed in some coal basins, as, for example, on the southern limit of the French and Belgian coal field, where similar outliers had been termed by M. Gosselet "lambeaux de poussée." But they occurred on a much smaller scale, and there was no reason why the phenomena should be considered otherwise than as quite exceptional. To recognize the generality of that class of stratigraphical accidents was a conquest of a high order, not only for Scottish geology, but for all countries where the work of orogenetic disturbances has for a long time suffered from the agencies of erosion. The Highlands of Scotland belong to that part of the old European continent which in earlier Palæozoic times emerged from the sea. Near the end of the Silurian period it was subjected to enormous pressure, which resulted in folding and breaking the whole border of the dry land, raising in the air a series of high mountainous ridges, the Caledonian chain of M. Suess. But millions of years have since passed over the land, and the continued action of atmospheric powers has left but a very small part of the original mass. It is extremely difficult, therefore, to restore the broken continuity; and through the quiet appearance of the now planed ground, the geologist is everywhere bound to search after the scattered signs of previous plication and fracture. This is now the task to be fulfilled by the detailed survey, and every stratigraphical difficulty has to be treated in the newly acquired light.

A few years after that discovery had been made in Scotland, Prof. Marcel Bertrand made in Southern France quite similar observations, showing that very limited patches of older formations, which had been till then regarded as remnants of ancient islets, projecting out of younger geological seas, were nothing else than outliers of reversed folds, the remainder of which had disappeared under the action of rain and rivers.

In this manner the correction of a long accepted error has led to stratigraphical conclusions of the highest import. In the meantime these gigantic displacements showed themselves accompanied by intense modifications of the rocks, so that Geikie was entitled to write: "In exchange for this abandoned belief, we are presented with startling new evidence of regional metamorphism on a colossal scale, and are admitted some way into the secret of the processes whereby it has been produced."

This is not the only occasion on which Sir Archibald has given proof of his readiness to admit frankly and decidedly the correction of opinions which have long been held. Some years ago, when the Lower Cambrian fauna had been detected by the officers of the survey much below the Durness limestone of the Highlands, in a series of strata which rests unconformably on the Torridon sandstone, he was the first to announce the fact before the Geological Society. The "Precambrian," which he had till then been rather reluctant to recognize, has now taken its place in the scale of divisions. Moreover, he has created a new name, that of "Dalradian," for the long strip of Precambrian deposits which extends from Donegal to the center and southwest of Scotland.

As one of the most characteristic formations in Scotland is the old red sandstone, we cannot be surprised that Sir Archibald has devoted much care to the description of the peculiarities of that interesting group of strata. After a long and detailed study of the whole ground, he has summed up his views in some important memoirs, published in the Transactions of the Royal Society of Edinburgh. There he has called again to life the old and long-extinct lakes, where the grits and conglomerates of the old red were piled up through the disintegration of surrounding formations, namely, Lake Orcadie, Lake Caledonia, Lake Cheviot, Welsh Lake, and Lake of Lorne; each of them being a separate basin, where the work of sedimentation has been many times interrupted by volcanic outbursts, while in the adjacent and more quiet seas there were accumulated the marine deposits of Devonshire.

But the chief work of Sir Archibald seems to be his exhaustive review of the volcanic history of the British Isles. While his brother, Dr. James Geikie, the author of "The Great Ice Age," has done excellent service by deciphering the marks of former ice action on the soil of the United Kingdom, Sir Archibald has been particularly attracted by the work of fire, *i. e.*, by the records of that volcanic activity the evidence of which is so deeply impressed on the scenery of the Hebrides, of Wales, and other districts of Great Britain.

The British Isles are now a very quiet ground, where explosive activity and projection of stones seem to be restricted to electoral periods, and although Scotland has been from time to time shaken by minor earthquakes, no human eye has ever seen there any volcanic outburst. Nevertheless, during Tertiary times, immense sheets of lava were poured out in the northwest of the country. To discern the site of the centers of eruption, and determine the old chimneys, the remnants of which give a glimpse into the lowest parts of ascending lavas; to discriminate the volcanic *necks*, the intrusive sheets and dikes, the bedded lavas and the tuffs—this was the first part of the task undertaken by Sir Archibald. But it was not enough for him to reascend in the past to the beginning of the Tertiary period. Not only in the old red of Scotland, but in the very heart of the oldest formations known in England and Wales, there were numerous evidences of previous volcanic activity. To use Geikie's words: "Placed on the edge of a continent and the margin of a great ocean basin, the site of Britain has lain along that critical border zone where volcanic energy is more active and continuous."

The chief outlines of that marvelous story, which was hardly suspected some years ago, were recently traced in Geikie's presidential addresses to the Geological Society of London; a work which has been qualified by Mr. Iddings, the distinguished American petrographer, as "one of the most important contributions to the history of volcanic action." Nevertheless, it is only a preliminary paper, and in the same manner as he already has devoted a special memoir to the volcanic outbursts of Tertiary times, Sir Archibald promises to publish in a short time a detailed account of the Palæozoic eruptions.

In order to become competent for such an undertaking, the author had prepared himself without sparing time, labor, or trouble. Having traveled over much of Europe, from the north of Norway to the Lipari Islands, he was anxious to learn from personal observation the broad features of that American continent the geological construction of which seems to have been conceived on a much larger scale than that of Europe. Therefore, in 1878, he rambled over many hundreds of miles in Western America, from the Archæan fields of Canada to the huge volcanic plateaux of Oregon and Idaho, where a country as large as France and Great Britain combined has been flooded with a continuous sheet of basalt. But stratigraphical studies were only part of the necessary initiation. Sir Archibald had been one of the first field geologists in England to perceive the importance of microscopic investigation as an adjunct to field work. He might well have left the care of that special study to some officer in the survey, but he wished to make himself master of the subject. Connected by personal friendship with Zirkel, Renard, and other eminent petrographers, he gave to that branch of the survey such a vigorous impulse that upward of 5,000 slices of British rocks were soon prepared and classed in the collections of the museum in Jermyn Street; and if he can now rely with full confidence on his distinguished professional officer, Mr. Harris Teall, for any determination of rocks, he himself has won all necessary competence in that department of science, which has been so much enlarged during the last twenty years.

An undertaking so ably provided for could not but prove successful. It is not, of course, our purpose to give an account of the results arrived at. The "History of Volcanic Action in the Area of the British Isles," as it was presented in the presidential addresses for the years 1891 and 1892, is so much condensed that it must be read *in extenso* by every one who takes interest in the matter. We would only call attention to the final summary, where some important and far-reaching conclusions are deduced from the observed facts. One of them is that British volcanoes have been active in sinking rather than in rising areas; to which it is added that the earlier eruptions of each period were generally more basic, while the later intrusions were more acid.

When presenting "a connected narrative of ascertained knowledge regarding the successive epochs of volcanic energy in this country," Sir Archibald did more than write an important chapter of British geology. It may be said that he definitively settled the long-controverted question, whether there has been any essential difference or not between the display of volcanic activity at various geological periods. Not very long ago some scientific schools—above all, on the Continent—showed the greatest reluctance to admit that true volcanoes could have existed during the Palæozoic era. When they were told of Cambrian lavas and felspathic ashes, of Silurian tuffs, especially of Precambrian felsites, they could not restrain a strong feeling of incredulity. Against old granitic or porphy-

ritic eruptions they had nothing to object; but the volcanic *facies* appeared to them a privilege restricted to recent geological times. To this the present writer might bear personal testimony, as he found his "way of Damas" only when he was fortunate enough to ramble over North Wales, and gather with his own hands pieces of vesicular lava embedded in the tuffs of the Snowdon, or bowlders of true felsite, lying at the base of the Cambrian series at Llanberis.

Not only has Sir Archibald, in common with his countrymen, always escaped that kind of misconception, but he will have contributed more effectively than any other to place the matter in the true light. Thanks to the cliffs of Scotland, he has been able to trace the roots of old volcanoes, to show true volcanic bombs entombed in sediments, and to mark the site round which vast piles of lavas and tuffs, 5,000 or 6,000 feet in thickness, had been heaped up. Likewise, in his previous paper on Tertiary volcanoes, he had established by indisputable sketches that the granitic rocks of the islands of Mull and Skye were ejected during the earlier part of the Tertiary period, and that they belong to the central mass of intrusions, the lateral veins of which have taken the form of granophyres.

There is another kind of useful geological work which Sir Archibald has a right to be credited with: we allude to the restoration of the most friendly relations between the official survey and the Geological Society of London. For many years those relations had been maintained at a rather low temperature; both independent geologists and government surveyors showed, as it were, more inclination to mutual and severe criticism than to brotherly co-operation. This period of misunderstanding is now well over. Thanks to the present director, the Geological Society has more than once received the early flower of the capital results obtained by the survey, and the recent presidentship of Sir Archibald has solemnly sanctioned the return of a harmony which will prove of great benefit to the advancement of geological science in England.

This is a very brief and imperfect account of the chief work accomplished by the field geologist, a work which would have been sufficient for the whole of a man's life. But we have now to consider in Sir Archibald the master who has been engaged in important educational duties. When he was appointed in 1871 to the chair of geology at Edinburgh he had the whole work of that department to organize, a task which may be wearisome, but which involves great benefit for a man of labor, as he must face every difficulty, and obtain day by day a clear and personal idea of all that is required for teaching. To that we are indebted for the undisputed superiority which Sir Archibald has displayed in his "Text-book," as well as in his other educational writings, such as the "Class Book," a very model of clearness, whereby it has been once more demonstrated that those only are qualified for writing elementary books who are in the fullest possession of the whole matter. Likewise he is the author of small books or "primers" on physical geology and geography, of which some hundreds of thousands of copies have been sold, and which have been translated into most European languages, as well as into some Asiatic tongues. This exceptional success will be easily understood if we remember that in Sir Archibald's works the traditional barrenness of geology is always smoothed and adorned by a deep and intense feeling for nature. Nobody has done more than he to associate geological science with the appreciation of scenery. In numberless writings he has undertaken to explain the origin of existing topographical features. Among others, reference may be made to the volume on "The Scenery of Scotland Viewed in Connection with its Physical Geology," first published in 1869, of which a new edition appeared in 1887; also to "Geographical Evolution," in the Proceedings of the Royal Geographical Society for 1879; and "On the Origin of the Scenery of the British Isles," published in *Nature* (vol xxix., pp. 347, 396, 419, 442).

Nevertheless, whatever might have been the attainments of the geologist and of the teacher, they would not have been sufficient to secure universal recognition had not Sir Archibald been provided in addition with the best powers as a writer. From the beginning he was strongly convinced of the importance of cultivating the literary element in scientific exposition, not only in order to make science interesting and intelligible to those outside the circle of actual workers, as he did in writing "Geological Sketches at Home and Abroad," but because he did not admit the right of a man of science to appear before the public without putting on the "nuptial dress." Every one who knows Sir Archibald will readily admit that in doing so he is not impelled by a desire for personal display. He is essentially a man of thought as well as of action. "*Res non verba*" might well serve him as a motto, and whoever has seen his silent but piercing attention in listening to some scientific controversy would never be tempted to suspect him of a wish to search after resounding manifestations. But he has too much of the artist's temper to neglect correctness and elegance in the utterance of his thoughts. And since nothing in the world is less common than the union of scientific insight and acuteness with a vivid appreciation of nature and a delicate feeling for style, it is not strange that Sir Archibald's fame has passed far beyond the circle of professional men. The portrait will be duly completed when it is added that no one could have a better renown for frankness, fair dealing and perfect trustworthiness in every relation of life.

It is highly gratifying for England that the recognition of such achievements has not been left to future times, and that the present generation has not failed in the duty of rewarding so much continuous and fruitful labor. He was admitted to the Royal Society before reaching the age of thirty, a most unusual honor; he has been vice-president, and was recently elected foreign secretary of that society. Since 1890 an associate of the Berlin Academy; elected by the Royal Society of Sciences at Gottingen, after the death of Studer, the Nestor of Swiss geologists; enrolled among the members of the Imperial Leopold-Caroline German Academy, of the Imperial Society of Naturalists of Moscow, etc., he was chosen in 1891 as a correspondent by the French Academy of Sciences, and in the same year he was made a knight. An honorary LL.D. of the Universities of St. Andrews and Edinburgh, he has received the Murchison medal of the Geological Society of London, and twice the Mac-Dougal Brisbane gold medal of the Royal Society of Edinburgh has been conferred on him, in recognition of the zeal and skill displayed in explaining the geological peculiarities of his mother-land. He is now at the summit of his career, and not so heavily laden with years but that we may express for him the wish *ad multos annos*. Let us hope that he will long remain at the head of the distinguished staff to which he has given so profitable an impulse, and continue to serve as a comforting example for those who refuse to acknowledge any other means of genuine success than constant labor and faithfulness to duty.

A. DE LAPPARENT.

HEAT AND CHEMICAL ENERGY.

By A. NAUMANN.

ON THE TRANSFORMATION OF HEAT INTO PERMANENT CHEMICAL ENERGY IN THE PRODUCTION OF WATER PRODUCER GAS AND CARBONIC ACID PRODUCER GAS.*

THREE methods are chiefly available for the transformation of coal into heating gas: the production of illuminating gas by destructive distillation of coal, that of water gas by the action of steam or the elements of water on heated fuel, and that of producer gas or carbonic oxide from coal supplied with air.

In the production of illuminating gas only a small fraction of the heat energy of the coal is transformed into gaseous fuel. The relatively high price of this gas prevents its application on a large scale as a heating gas; on a small scale it is employed for heating purposes and motive power in the absence of a cheaper gaseous fuel, and because it can be obtained in all large towns.

The formation of water gas is endothermic; heat is absorbed according to the thermochemical equation:

$$H_2O\text{ (liquid)} + C = H_2 + CO \ldots -38{,}770\text{ calories.}$$

The somewhat complicated apparatus required for the production of water gas only allows of its preparation with advantage on a large scale, but in that case the advantage is so considerable that in the towns of North America water gas has been substituted, to a great extent and sometimes altogether, for illuminating gas for lighting purposes, its lighting power being obtained by so-called carbureting.†

The production of producer gas is comparatively simple and easily carried out. The formation of producer gas is exothermic; it liberates heat.

$$C + \underbrace{O + 53{\cdot}6\text{ parts by weight of nitrogen}}_{\text{air}} =$$

$$\underbrace{CO + 53{\cdot}6\text{ parts by weight of nitrogen}}_{\text{producer gas}} + 29{,}690\text{ calories}$$

The amount of heat here indicated causes the theoretical temperature of producer gas at the moment of its formation to be 1,446° Cent., assuming that the specific heats of its constituents are the same at high as at ordinary temperatures. The heat of formation (29,690 calories) thus indicated is utilized if the gas be consumed on the spot as fast as it is produced, but is lost if the gas is conveyed to any distance or stored and allowed to cool to the ordinary temperature of the air, 15° Cent., the amount of heat then available being only that evolved by the combustion of the carbonic oxide in the gas—that is, 67,960 calories. Out of a total of 97,650 calories available, only 67,960 calories would be utilized in the latter case, corresponding to a waste of 30·4 per cent. of the theoretical quantity of heat available.

Two methods are within our reach for converting into permanent chemical energy the quantity of heat appearing in the form of high temperature in the producer and incorporating it in the gas.

Either so much water may be introduced into the producer with the air as to absorb from the heat generated (+29,690 calories) by being decomposed in contact with the fuel, thereby producing hydrogen and carbonic oxide, which mix with the ordinary producer gas generated at the same time, enriching it and forming a heating gas, which may be called water producer gas; or carbonic acid may be similarly introduced into the gas producer to form carbonic oxide, which mixes with the ordinary producer gas, generated at the same time, forming a heating gas which may be called carbonic acid producer gas.

In the following tables for each of these two heating gases the composition, heat of combustion, rise of temperature of the flame, and heat given up by the products of combustion for a reduction of 1° in temperature are compared with the corresponding amounts for producer gas. I may here mention that the method of procedure for determining these values is tedious and troublesome, and I therefore limit myself to tabulating the results.

The composition of water producer gas from fluid water at 15° and gaseous water at 15° is calculated from the following thermochemical equations II. and III., and that of carbonic acid producer gas from equations I. and IV.

$$\text{I.}\quad C + \underbrace{O + 53{\cdot}6\text{ parts by weight of nitrogen}}_{\text{air}} =$$

$$\underbrace{CO + 53{\cdot}6\text{ parts by weight of nitrogen}}_{\text{producer gas}} + 29{,}690\text{ calories}$$

$$\text{II.}\quad H_2O\text{ (liquid)} + C = \underbrace{H_2 + CO}_{\text{water gas}} - 38{,}770$$

$$\text{III.}\quad H_2O\text{ (gaseous at 15°)} + C = \underbrace{H_2 + CO}_{\text{water gas}} - 27{,}970$$

$$\text{IV.}\quad CO_2 + C = 2\,CO - 38{,}270$$

In the following tables are given separately, first, the volumes of the gases formed and mixed in the producer and of the water gas which together form water producer gas; and, secondly, the volumes of the chemical constituents of those gases; for carbonic acid producer gas the volumes of the producer gas and the carbonic oxide formed by the reduction of the carbonic acid introduced into the producer are first given, and afterward the volumes of the chemical constituents of those gases.

I.—Composition of producer gas from pure carbon:

Carbonic oxide	34·3 per cent.	by volume.
Nitrogen	65·7 "	"
	100·0	

II.—Composition of water producer gas:

		From liquid H_2O at 15°.	From gaseous H_2O at 15°.
		Percentage by volume.	
1.	Producer gas	65·55	57·9
	Water gas	34·45	42·1
		100·00	100·0
Equivalent to:			
2.	Hydrogen	17·2	21·1
	Carbonic oxide	39·7	40·9
	Nitrogen	43·1	38·0
		100 0	100·0

III.—Composition of carbonic acid producer gas:

		Percentage by volume.
1.	Producer gas	65·3
	Carbonic oxide made from carbonic acid and carbon	34·7
		100·0
Equivalent to:		
2.	Carbonic oxide	57·1
	Nitrogen	42·9
		100·0

A glance at the above volume percentage composition of the three heating gases shows at once the superiority of water producer gas and of carbonic acid producer gas over ordinary producer gas. This superiority is shown still more clearly by a comparison of the following values: 1. The heat of combustion of a liter of each gas calculated from the above composition and the known heat of combustion of their constituents. 2. The rise of temperature of the flame calculated from the temperature of combustion and specific heat and quantity of gases existing after combustion. 3. The heat given off by the products of combustion of a liter of gas by reducing the temperature 1°.

For comparison these values are also calculated and given for water gas, it being assumed that combustion in all cases is effected with only the quantity of air theoretically necessary.

Heating Gas.	Heat of Combustion of 1 Liter of Gas, the Water Produced being Assumed to be Gaseous at 15° C.	Rise of Temperature of Flame.	Heat Units given up by the Products of Combustion from 1 Liter of the Gas in Cooling 1°.
	Calories	Degrees	Calories
1. Producer gas	1044	1904	0·5487
2. Carbonic acid producer gas	1739	2449	0·7101
3. Water producer gas from liquid water at 15°	1652	2356	0·7016
4. Water producer gas from gaseous water at 15°	1790	2431	0·7363
5. Water gas	2812	2830	0·9034

The above changes of sensible heat into permanent chemical energy, which have been theoretically and experimentally determined, have also been applied in practice.

The so-called Dowson gas* is technically water producer gas, where for its production air and steam are introduced together into the hot fuel. The values for the steam only vary slightly from those given above for water steam at 15°, as the difference between the heat of evaporation of water at 15° and at higher temperatures is but slight. Such water producer gas had, according to Dowson's† own data, the following composition, I.; another, according to a paper of Schilling,‡ has the composition II.

Constituents.	I.	II.
	In volumes per cent.	
Hydrogen	18·73	17
Carbonic oxide	25·07	23
Methane	0·31	2
Ethylene	0·31	—
Carbonic acid	0·57	6
Nitrogen	48·98	52
Oxygen	0·03	—
	100·00	100·0

The discrepancies in the composition of theoretical water gas and of that used in practice are explained by the consideration that the latter contains carbonic acid, which if completely reduced would give double its volume of carbonic oxide, and that pure carbon is assumed to be used in the formation of theoretical water producer gas in the above calculations.

In Dowson's arrangement the excess heat of production of the producer gas is actually transformed into the chemical energy of water gas, produced by the simultaneous introduction of air and steam into the producer, and their decomposition by the coal, which,

* "Berichte der Deutschen Chemischen Gesellschaft," No. 25, 1892. *Engineering*.

† Hence my opinion as regards water gas expressed more than ten years ago in the last sentence of my paper, "The Question of Heating, with special reference to the Production of Water Gas and Heating by Water Gas" (Giessen, J. Ricker's Library, 1881, page 96), has been proved to be correct; "and where the theory indicates such favorable prospects its practical application should follow."

* "Journal fur Gasbeleuchtung," 1881, page 674, German patent No. 27,165; see Wagner Fischer, "Jahresber. Chem. Tech.," 1887, pages 189 to 193. In 1885 Dowson gas had already been frequently used in England for heating, melting and motive power. But water gas can also be used, at least in those cases in which it can be burnt on leaving the producer. See T. A. Jahn's separate print, "Two Furnaces Worked by Illuminating Gas, etc.," Prag, October, 1881, published by the author. Later still, J. Quaglio referred in his paper, "Water Gas as the Fuel of the Future," Wiesbaden, 1880, page 23, to the use of water producer gas, but has more recently shown it to be impracticable on account of the amount of nitrogen. In the Frankfort Electro-Technical Exhibition, 1890, a water gas producer was set up to drive a gas motor of 60 horse power in the machine hall, which was coupled with a dynamo used for charging the secondary battery in the theater.

† Wagner Fischer, "Annual Chem. Tech.," 1887, page 171.

‡ R. Biedermann, "Chem. Tech. Annual," 1889-90, pages 12 and 305.

being added to the producer gas, forms water producer gas.

In the new form Siemens furnace* the same *modus operandi* is partially carried out; steam is also blown into the producer, and besides this a portion of the products of combustion is led into the producer at a high temperature. As these products of combustion contain steam as well as carbonic acid, both water gas and also carbonic acid producer gas are formed. The sensible heat is here converted into chemical energy by the conversion of steam into water gas ($H_2O + C = H_2 + CO$), and the CO_2 into CO ($CO_2 + C = 2\,CO$), the result being an increase of the hydrogen and carbonic oxide in the gas made. To produce water gas from steam and hot carbon without any extraneous heat, the steam would have to be introduced at the temperature of 3,230°. To produce carbonic oxide from carbonic acid and heated carbon without any extraneous heat, the carbonic acid would have to be introduced at a temperature of 4,008°. However, the nitrogen contained in the hot products of combustion carries with it a considerable amount of heat, which is available for the above-named processes of conversion. But the introduction of relatively large volumes of nitrogen contained in the products of combustion into the gas producer, and thus going into the heating gas produced, prevents the total utilization of the products of combustion in this manner. Therefore in the new form Siemens furnace not more than half the products of combustion are returned to the gas producer. The theoretical limit of this amount depends upon the temperature of the returned products of combustion, also on their composition, as per table below, assuming that only the theoretical amount of air required for perfect combustion is used and taken with reference to the calorific and other values given above for one liter of producer gas, water producer gas, carbonic acid producer gas, and, for comparison, also water gas.

Weights of products of combustion in grammes in one liter of theoretical heating gas:

Heating Gas.	Products of Combustion in Grammes.		
	CO_2.	N.	H_2O.
1. Producer gas	0·6762	1·6474	
2. Water producer gas from gaseous water at 15°	0·806	1·965	0·171
3. Carbonic acid producer gas	1·125	1·909	
4. Water gas	1·064	3·207	0·504

According to scientific observation these are the highest results which can be attained theoretically for converting sensible heat into chemical energy for water producer gas and carbonic acid producer gas. A comparison of these with the results already obtained in practice would be a guide as to how far the heat in various fuels can be utilized to the best advantage, and so avoid errors in treating fuel.

* English patent No. 4,544, of 1889.

BACILLI IN BUTTER.

By GRACE C. FRANKLAND.

THE fact that milk affords a particularly suitable medium for the growth and multiplication of most micro-organisms has rightly led to its being regarded as a dangerous vehicle for the propagation of disease. On the Continent the practice of boiling all milk before use, and so destroying any pathogenic microbes which may be present, is almost universal, and recently a number of special pieces of apparatus have been devised for household use, insuring the efficient so-called "pasteurization" of milk. In England, however, we but rarely boil our milk, in spite of outbreaks of diphtheria and typhoid fever having been not infrequently traced to a particular milk supply. In a paper by Cnopf on the bacterial contents of milk it is stated that on one occasion out of every thirteen samples of milk supplied to Paris one was found to contain tubercle bacilli, while it is well known that the germs of typhoid, cholera, diphtheria, anthrax, etc., thrive readily in this medium. But although milk has been made the subject of much careful experimental investigation, comparatively little is known of the microbial condition of butter. Heim has shown that cholera bacilli purposely rubbed into butter could be demonstrated after thirty-two days, while typhoid bacilli similarly introduced were found after three weeks, and tubercle bacilli after the lapse of a month, although Gasperini discovered the latter in butter even after 120 days. Quite recently Lafar has published a paper, "Bacteriologische Studien uber Butter," in the *Archiv fur Hygiene*, in which he has recorded his investigations on the micro-organisms found in Munich butter. These experiments are instructive as exhibiting the fitness of butter to support a large number of bacteria, and thus furnish an interesting supplement to what is already known concerning the longevity of pathogenic microbes in this medium. The samples examined were prepared from fresh cream and were investigated as soon as possible after the butter was made. It was found that the number of microbes differed according as the portion for experiment was taken from the outside or from the interior of the piece of butter. Thus in one instance while one grm. from the center of the pat contained 2,465,555, on the outside in the same quantity as many as 47,250,000 micro-organisms were found. Taking the average of a number of examinations, it was estimated that the interior of a lump of butter possessed from 10 to 20 millions of bacteria in a single grm. Lafar is inclined to regard this as an under rather than an over statement of the number, inasmuch as there are always probably present a certain proportion of microbes which will not develop at the ordinary temperature, or on the gelatine-peptone medium usually employed. He graphically puts it that in some cases it is conceivable that the number of organisms swallowed with a moderately sized slice of bread and butter may exceed that of the whole population of Europe! Lafar found that butter kept in a refrigerator with a temperature of between 0° to + 1° C. at first (after five days) showed a marked reduction in the number of bacteria, but that no further diminution took place, although the sample was kept for a month at this temperature. Samples kept at from 12° to 15° C. exhibited a marked increase in the number of micro-organisms, a rise from 6 to 35 millions being observed in the course of 9 days, while when placed in the incubator (35° C.) after 4 days the bacteria had fallen from 25 to 10 millions, and after 34 days only 5 per cent. of the original number present were discoverable. Experiments were also made to ascertain what was the bacterial effect of adding salt to butter kept in a refrigerator. It was found that although the numbers were thereby considerably reduced, yet, even when as much as 10 per cent. of salt was added, the complete destruction of the bacteria was not accomplished. On examining, however, gelatine plates prepared from these samples, it was ascertained that the organisms present consisted almost entirely of a pure cultivation of one particular microbe, which was apparently entirely unaffected by the addition of salt, and had grown and multiplied to the exclusion of nearly all the other bacteria originally present. When samples similarly salted were placed in the incubator (35° C.) the result was rather different, for while there was more apparent connection between the proportion of salt added and the diminution in the number of bacteria, more varieties of micro-organisms were found on the gelatine plates. But in this case, also, the germicidal effect produced was not proportional to the increase in the amount of salt. Samples of artificial butter were also examined, and were invariably found to be much poorer in bacteria than ordinary butter. Thus, while the smallest number found in one grm. was 747,059, in real butter considerably over two million microbes was the minimum. Two varieties of bacilli have been isolated and described, which were found very constantly present in butter throughout these investigations. They are beautifully illustrated and shown in colored plates as individual organisms and colonies at the end of the paper. Lafar purposes continuing his investigations, and it is to be hoped that the examination of butter for pathogenic micro-organisms, about which so little is known, will form an important feature in any further researches he may undertake.—*Nature.*

GLYCERIN.*

By J. LEWKOWITSCH, Ph.D.

AT the outset, I wish to disclaim any intention on my part of bringing anything new before you. But having been asked to say something about glycerin—with the manufacture of which I am connected—I thought I might perhaps supplement the remarks made last year by Mr. Siebold and several other gentlemen in the discussion following Mr. Siebold's paper.

This will be done mostly from the manufacturer's point of view, as manufacturing processes cannot be supposed to be generally known, and it is not at all unlikely that erroneous opinions may be current among those not conversant with practical processes used in chemical works.

During the last year it has been repeatedly stated that some samples of glycerin destined for pharmaceutical purposes contained arsenic, a fact which was not unknown to manufacturers, but on which for very obvious reasons they did not care to enlighten the consumers. The arsenic in the glycerin owes its existence only to the arsenic contained in the reagents used in the manufacturing process. It has been pointed out by several gentlemen in last year's discussion, that glycerin purified by distillation would not be contaminated by this poisonous substance; although it is but fair to say that Mr. Allen had some doubts about it, still, in the concluding remarks it was distinctly stated that arsenic could be removed by distillation.

This is not so, as the simple fact will show that now all glycerin for pharmaceutical purposes is distilled, nay, even double distilled, glycerin. The times when glycerin was being prepared by other processes of refining have gone by, and a glycerin which had not been purified by steam distillation would be unsalable for pharmaceutical purposes.

But to remove every doubt I prepared the substance formed when arsenious acid is dissolved in glycerin, a substance which has been described by Schiff, and later on by Jackson, who apparently overlooked the earlier publication of Schiff. This substance is the arsenious ether of glycerin, $AsO_3(C_3H_5)$. On being heated to 250° C., it decomposes, while arseniureted hydrogen and other volatile arsenious compounds distill over. At the same temperature glycerin distills also over, and it is quite evident, therefore, that any arsenic contained in glycerin will distill along with it. The experiments which I carried out could not show any other result.

Arsenic contained in glycerin cannot be removed by distillation, and to my knowledge there is no process known for completely freeing glycerin from arsenic on a practical scale.

Pure glycerin, free from arsenic, can therefore be obtained from such sources only where reagents not contaminated with arsenic are being used. As it has been suggested last year that glycerin emanating from certain processes ought to be rigorously excluded by the Pharmacopœia, I may be allowed here to very briefly review from our point of view the processes used for manufacturing glycerin. The raw materials are exclusively fats and oils which yield on saponification or hydrolysis the glycerin as a by-product.

Glycerin free from arsenic will be obtained in those processes where the fats are hydrolyzed by means of water, whether it be used in the liquid state, under high pressure, or as superheated steam. The lime saponification, which is yet largely practiced, especially in smaller works, will, as a rule, also yield an arsenic-free glycerin. On the contrary, all glycerin coming from works where the sulphuric acid saponification is practiced will contain arsenic, as the glycerin will extract all the arsenic from the sulphuric acid. There is, however, no doubt that even such glycerin would be pure, as far as arsenic is concerned, if sulphuric acid free from arsenic were used, as it may be prepared from the sulphur obtained by Chance's process.

There is consequently no doubt that there are sources from which one may easily obtain a pure glycerin. With a view to ascertain whether there are in commerce samples of glycerin absolutely free from arsenic—for in many works several processes are simultaneously used, and the glycerin will be mixed in the end—I examined ten samples of glycerin coming from ten different works. As I wished to detect smallest traces, I used silver nitrate instead of mercuric bichloride. Three of the samples would have to be rejected, four samples contained very small traces, which might be disregarded, while three only were absolutely free from arsenic.

There is still another process for saponifying fats, and consequently manufacturing glycerin, practiced on a very large scale indeed—that which yields the soap lye glycerin. At last year's conference the glycerin derived from that source was very badly treated, and it was demanded that soap lye glycerin ought to be entirely excluded from pharmacy. Unnecessary precaution!—up to now, at least; for no chemically pure glycerin has been prepared hitherto from soap lees, owing to the difficulties incident to the purification of it.

Being wishful to prove here that soap lye glycerin has a far worse reputation than it—or, or let me say some of it—deserves, I undertook during the last few weeks to prepare chemically pure glycerin from soap lees, not in the laboratory, but on a large scale in the works. I had to use such glycerin as I just had at hand, and as this contained, owing to the impure reagents, some arsenic, I had on starting to expect a glycerin containing traces of arsenic; but this is, from reasons pointed out above, only of secondary importance, as, on repeating the manufacture of it, I shall have to start with purer reagents, and the real difficulties are lying in quite another direction.

Arsenic, although the most objectionable impurity, is, however, not the only one which may be found in "chemically pure" glycerin. As the British Pharmacopœia treats glycerin somewhat cursorily, I may be allowed to point out here one or two tests which will perhaps be found useful.

The glycerin may contain organic impurities, either fatty acids, etc., or so-called polyglycerols, under which name I may summarize all those substances having a higher boiling point than glycerin itself. The way to test for the latter is to gently evaporate a known quantity of glycerin in a platinum dish at a temperature of 160° C. The residue left, from which the ash subsequently found on incineration has to be deducted, will give a fair indication as to the care with which the glycerin has been distilled.

The following table gives the residues for eight "chemically pure" glycerins, arranged according to the quantity of organic residue, to which I have added the analysis of the soap lye glycerin:

	Organic residue. Per cent.	Ash. Per cent.
1	0·0243	0·00603
2	0·0327	0·0050
3 (*a*)	0·0328	0·0140
(*b*)	0·0267	0·0102
4	0·0360	0·0138
5	0·0371	0·0081
6	0·0443	0·0066
7	0·0738	0·014
8	0·0751	0·0154
9	0·0931	0·0305

No. 3 represents the figures found for two batches of the soap lye glycerin, which I have shown.

Fatty acids, as butyric acid, etc., and other organic impurities will be easily detected by testing with ammoniacal silver nitrate at ordinary temperature, which is recommended by the German Pharmacopœia.

It is required of a good glycerin that it should not reduce the silver within fifteen minutes. This test is far more delicate than that in which silver nitrate alone is used, as the manufacturers of cosmetics do, who reject any glycerin which reduces silver nitrate in less than twenty-four hours. I think that the test with ammoniacal silver nitrate is a little too rigorous, as ammoniacal silver nitrate is easily reduced by glycerin at an elevated temperature; in fact, of all the glycerin samples I examined, there were only two (Continental ones) which fairly responded to this test, while all others would have to be rejected. Testing with nitrate of silver alone would perhaps be sufficient to show whether there are any silver nitrate-reducing substances in the glycerin.

Under No. 68 of the blue list an answer is requested to the question how to estimate glycerol in pharmaceutical preparations. I am afraid there is no satisfactory answer to that question, as we are not yet in possession of sufficient quantitative material. Lately, two methods have been proposed for the estimation of glycerol, which seem specially suitable in a great many cases, unhappily not in all. The first method, based on oxidation of glycerol to oxalic acid, can only be of use where no other organic substance is present which might yield oxalic acid. The glycerol in glycerinum aluminis might be thus estimated. The second method—boiling of glycerol with acetic anhydride and sodium acetate—requires highly concentrated solutions, and would, of course, be completely useless when other substances are present which combine with acetic anhydride, as would be the case with, *e. g.*, glycerinum acidi carbolici, or glycerinum acidi gallici and glycerinum acidi tannici. For such preparations it would be required to have a method for completely transforming the glycerol into a weighable substance, *e. g.*, a tribromine derivative.

* British Pharmaceutical Conference, Leeds.

PHYSICAL PHENOMENA AT LOW TEMPERATURES.

PICTET has experimented on the chemical and physical phenomena observable at very low temperatures. He finds that by means of powerful compressors and aspirators, a mixture of sulphur dioxide and carbon dioxide will give a temperature of −110°, nitrogen monoxide and ethylene about −150°, and air a minimum temperature of −210° to −213°. These low temperatures were measured with a dry hydrogen thermometer, or by alcohol or ether thermometers, verified by the hydrogen thermometer. The author observes that the very long radiant waves emitted at these very low temperatures pass readily through almost all bodies. Thus a vessel at −110° for example will cool with practically the same rapidity whether the layer of cotton enveloping it be 50mm or 10mm or only 2mm in thickness. Moreover, he finds that when chloroform is immersed in nitrogen monoxide at −120°, a ther-

mometer placed in it sinks to —68·5° and crystallization begins. If transferred to a mixture of carbon dioxide and sulphur dioxide at —80°, the thermometer falls to —80° and the crystals of chloroform melt again. Replaced in the nitrogen monoxide at —120°, the thermometer rises to —68·5° and crystallization begins again. At —83·5° the crystals remain stationary, increasing when the temperature falls and melting when it rises. Since crystallization takes place on the inner wall when the vessel is cooled at —120°, it seems probable that the thermometer in the middle is affected by the heat of crystallization and at —68·5° is in dynamic equilibrium with the medium in which it is immersed. At —80° no crystals are formed and the thermometer is affected by radiation only.—*C. R., J. Chem. Soc.*

PERFUME IN FLOWERS.*

By E. Mesnard.

The insufficient nature of the micro-chemical methods usually employed has so far prevented an exact knowledge being obtained of the manner in which the perfume of flowers is produced. I have applied to this class of researches a general method which has served in the localization of fixed oils. The section being placed in a drop of pure glycerin, is arranged upon a round cover glass, which, being then inverted, serves as a cover to a small chamber formed by cementing a glass ring to an object slide. In the interior of the chamber is fixed another ring of smaller diameter and somewhat less in height, thus forming with the first an annular space in which the reagent may be placed. By adopting this arrangement the light passing through the central part of the cell is not modified. The inner ring will further serve to support a very small cover glass, upon which sections may be arranged which require to be exposed to the action of the reagent for some length of time, as occasionally happens in the case of the fixed oils. The reagent invariably employed is pure hydrochloric acid, the hydrated vapors from which are readily absorbed by the glycerin. In this way, by a gentle and easily regulated action, I obtain complete hydration of sections in the presence of an acid. When they have been exposed for a short time, the essential oils appear as minute spherical drops of a fine transparent golden yellow. If the action be prolonged, the drops disappear, being transformed into diffusible products. This tendency of the globules is not seen in the fixed oils, so that it provides a means of distinguishing these two classes of products.

Jasmin.—In this flower the essence is situated in the row of epidermal cells on the upper side of the petals and sepals. Some exist also in the corresponding layer on the under surface, where the sepals are colored by a violet pigment. If the evolution of the cell contents in flowers at different stages of development be followed, at first nothing but chlorophyl is found in the tissue; tannin appears next, or rather intermediate glucosides, difficult to identify by means of the ordinary tests for these substances. These glucosides furnish the tannin and pigments of the lower surface of the sepals. The hydrochloric acid vapors distinguish all the tannoid compounds intermediate between the chlorophyl and tannin or pigments on the one hand and between the chlorophyl and essential oil on the other. The explanation of these facts seems to be as follows: Whereas upon the lower surface, which was exposed in the bud to the action of light and the oxygen of the air, the tannoid compounds were slowly oxidized and gave rise to tannin, upon the upper surface which was hidden in the bud these agencies were inoperative, and the same compounds were converted into essential oil, which oxidizes in contact with the air and produces the sensation of perfume.

Roses.—The essence in roses is found in the papilliform epidermal cells† on the upper surface of the petals, scarcely ever on the lower side. The origin of the essence is easily recognized as being the same as in the preceding case. The delicacy and the special odor of the essence furnished by each variety of rose seems to depend upon the more or less complete transformation of the intermediate tannoid compounds derived from the chlorophyl.

Violets.—The essence is here similarly situated. It is necessary, however, before applying reagents to the sections in this instance to immerse them in tungstate of sodium solution for some minutes, in order to precipitate the tannin. The essential oil then appears bright red.

Tuberose.—In this case the essential oil is found upon the lower surface of different parts of the perianth. The intermediate cells contain a fixed oil. Tannin is scarcely perceptible. Here then, in consequence of the abundance of chlorophyl in the first place, of the almost complete absence of tannin, and also, probably, of the presence of fixed oil which has swept it toward the periphery, the essential oil is carried toward the lower surface. The intense odor of the tuberose only commences to reveal itself when the oil is enabled to form itself into small drops under the influence of the reagent.

Orange.—The reagent discloses the presence of several distinct essences in orange blossoms. First there is that of the secretory sacs which occur on the lower surface of the petals or sepals. This is not essence of neroli, as is generally supposed, but an essence analogous to that of petit-grain. By skillfully eliminating these sacs in an unopened bud, the agreeable odor of the flower when it afterward expands is in no degree injured. Essential oil is still found in the epidermis on both surfaces of the petals, and likewise upon the periphery of the petaloid filaments of the stamens. By systematically preventing, in various ways, the liberation of the perfume in these different regions, I have been able to assure myself that the odor from the upper surface of the petals alone corresponds to the finest neroli. The odor of the flower then is a mixture.

The conclusions to be drawn from these researches are:

(1) That the essential oil is generally found localized in the epidermal cells of the upper surface of the petals or sepals, though it may exist upon both surfaces, especially if the floral organs are completely hidden in the bud. The lower surface generally contains tannin or pigments derived from it.

(2) The chlorophyl seems, in every case, to give rise to the essential oil. This transformation is readily comprehended if it be admitted, as is generally understood, that the floral organs are but modified leaves found performing a new function. The chlorophyl, being thus diverted from its original purpose, may be transformed into permanent tannoid compounds or into essential oils.

(3) The liberation of perfume in the flower only becomes perceptible when the essential oil is sufficiently freed ffrom the intermediate compounds which have given rise to it. Its formation is to some extent in inverse proportion to that of the tannin and pigments in the flower. This will explain why flowers with green petals possess no odor, why white flowers or roses are most frequently odoriferous, why the *Compositæ* which are so rich in tannin* have a characteristic disagreeable odor, and why the cultivated white lilac and forced roses acquire a very fine perfume.

* Adapted from the *Comptes Rendus de l'Académie des Sciences*; *Pharm. Jour.*

† Blondel, "Produits sodorants des Rosiers" ("These de la Faculte de Med.," 1889).

* L. Daniel, "Le Tannin des Composees" (*Rev. Gen. de Bot.*, ii., 391).

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